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CONTENTS.

AN ASTERISK (*) DENOTES AN ILLUSTRATED ARTICLE.

OFFICIAL NOTICE—

Annual Meeting American Gas Light Association..... 505

EDITORIALS—

Briefly Told..... 506

The Last Words—Will there be a Suit?—Notes.

CORRESPONDENCE—

Uniform Them..... 506

*Instruments for Measuring Radiant Heat, by C. V. Boys, F.R.S.... 507

*The Hamlin Gas Enricher..... 509

Some Reflections upon the Commercial Policy of a Gas Undertaking, by J. Carter..... 510

*The Averill Process and Apparatus for Manufacturing Wood Gas. 511

The Composition of Uncarbureted Water Gas..... 512

The Measure of Illumination..... 513

Why Mortar Hardens..... 513

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 514

Annual Meeting, Mansfield, O.—A Turbine Wheel for the Cohoes (N.Y.) Company's Electric Annex—Raising the Rates for Natural Gas—Public Lighting, Oakland, Cal.—Annual Meeting, Gate City Company—Differential Rates at Hartford, Conn.—Some Personals—Robbed by a Supposed Gas Meter Inspector—Public Lighting, Montclair, N. J.—The Board of Fire Underwriters Insist that Massachusetts Electric Companies shall Pay for an Inspection—What the Small Boy of Boston Does in May—Suing the Saratoga Gas Company—The Consolidation at Troy (N. Y.) Completed—Appeal d to a Higher Court—And Many Other Items.

The Market for Gas Securities..... 517

[OFFICIAL NOTICE.]

Annual Meeting, American Gas Light Association.

LAWRENCE, MASS., Sept. 11, 1889.

Section 12 of the Constitution is as follows:

"Section 12. *Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least ten days prior to the meeting at which the application is acted on.*"

To the Members of the Association: Gentlemen—As already announced, the Seventeenth Annual Meeting of the Association will be held at Baltimore, Md., on Wednesday, Thursday, and Friday, Oct. 16, 17, and 18. The headquarters of the Association will be at the Carrollton Hotel, which is conducted on the American plan. The meetings of the Association will be held in the Concert Hall of the Concordia Building, on German street near Eutaw.

As, in my circulars of July 29, I had considerable to say in the way of impressing upon members the necessity of procuring rooms in advance at the hotel, it is not necessary for me to say much on this point now. I would merely add, as a reminder, that the rate at the Carrollton is $3 per day, and if the members take the pains to write in advance for rooms they will all be taken care of.

I am assured by the Committee that the hall selected for the meetings of the convention is in all respects a desirable place. Certainly this is a good cause for rejoicing, because a suitable hall adds greatly to the pleasure of the meeting.

The Council has appointed the following gentlemen as the Committee to nominate officers for the ensuing year, namely: Chas. H. Nettleton, Birmingham, Conn.; Edward Lindsley, Cleveland, Ohio; D. H. Geggie, Quebec, Canada; Geo. S. Hookey, Augusta, Ga.; Ed. G. Cowdery, Milwaukee, Wis. Members who desire to see the names of any particular persons nominated for officers should make their preferences known to the members of the Committee.

I am requested to state that special arrangements will be made at Baltimore for the entertainment of ladies accompanying members to the meeting.

There is no change in the literary part of the programme, which is as follows:

"Fuel Gas," by Walton Clark.

"Care and Operation of Gasholders," by C. L. Rowland.

"Illuminating Water Gas—Past and Present," by F. H. Shelton.

"Leakage and Condensation," by E. C. Jones.

"Purification of Gas from Kansas Coals," by B. E. Chollar.

"Conduct of the Electric Light Business in Connection with the Gas Industry," by W. H. Pearson.

"Advantages of Supplying a Mixture of Coal and Water Gas," by T. G. Lansden.

"Some Thoughts on Fuel Gas, Induced from Practical Experience in the Distribution of Natural Gas," by John Young.

"Gas Calorimetry," by Prof. E. G. Love.

No particular effort has been made to add to the number of papers

during the last month, as it is thought that to thoroughly digest these dissertations will take up all the time of the meeting. I have the following conundrums for the Question-Box:

"Is it wise to make a special discount on gas used for cooking and heating?"

"Is the scheme of introducing air into gas for the purpose of reviving the iron a success?"

"What progress has been made this year in the matter of regenerative furnaces?"

"How shall firebricks and tiles be laid, wet or dry?"

"What composition of gas will give the highest illuminating power when burned with a common fishtail burner burning 5 feet per hour, and convert all of the carbon into CO_2?"

"What specific gravity of oil will yield the greatest amount of gas with the highest illuminating power?"

"What chemical change takes place when a liquid hydrocarbon is exposed to a high temperature and made into a permanent illuminating gas?"

"Can electric lights be sold at a profit in towns of 8,000 inhabitants in competition with gas.?"

"Where should a gas company's ownership of service pipes terminate—at the street curb, lot line, or the meter?"

"Is it economy to use illuminating coal gas for fuel under boilers, with price of soft coal at $4.50 per ton? If it is, what kind of burners are generally used, and about what do same cost per set for furnace? If not, why not?"

"What proportion of the total is the present day consumption of gas in an average American city?"

If the members have any other questions for the box I would suggest that they be sent along as promptly as possible.

It has also been suggested to me that if I remind the members that there are four water gas processes in operation in Baltimore, the fact may serve as an extra reason why the members should strive to be present at the forthcoming meeting, as they will have the opportunity to examine these processes side by side, and thus be the more able to determine the value of each.

It is expected that the proper disposal of this programme in the allotted two days will be just sufficient tax on the energies of the members to make the relaxation of Thursday evening and Friday all the more enjoyable.

On the evening mentioned—the second of the meeting—the Association will be tendered a dinner by the Messrs. Bartlett, Hayward & Co. On Friday the Association will enjoy a sail down the beautiful bay, stopping at points of interest, and during the trip the members will be the guests of the Maryland Meter and Manufacturing Company. An inspection will also be made of the Chesapeake gas works, when we will be in the hands of the officers of the Consolidated Gas Company.

The Trunk Line Passenger Committee and the Central Traffic Association have granted us the usual rebate on railroad fares—namely, full fare going, and returning at one-third the usual rate, or, in other words, one-third off on the round trip. Members who wish to take advantage of the rebate must obtain the necessary certificate from the ticket agent at the starting point. These certificates must also be endorsed by me at the meeting.

The gold badge of the Association has recently been sent to each member. If any one on our roll has not received the pin, I would thank him to inform me of the fact promptly.

Yours truly, C. J. R. Humphreys, Sec'y.

BRIEFLY TOLD.

The Last Words.—Before this issue of the Journal shall have been distributed completely among our subscribers, the current meeting of the American Gas Light Association will have all but passed into history. Accordingly, no good purpose can be served by making extended comment on the prospects for the meeting, the advent of which has been amply heralded by the Secretary, who, in connection with the other executives and the local committees, cannot be charged with having neglected anything that would tend to advance the success of the convention. Reference to the Secretary's current circular shows that the paper list has been shortened by the withdrawal therefrom of the promised contribution on the "Gas Coals of the United States," from the pen of Mr. H. C. Adams. It is to be regretted that this topic has been cut out, for the author named is peculiarly well fitted to dilate understandingly on the theme, and many will be disappointed at the decision that the paper is not to be. This disappointment, however, will be tempered with genuine personal regrets when it is known that Mr. Adams could not prepare the paper because of the poor state of his health. His condition, we are pleased to add, improves, and we may possibly count on him to redeem the failure of 1889 in the presentation of a similarly-named paper at the gathering of 1890. The question list, it will be noted, has been materially added to, and the latest conundrums ought to produce some very practical "talk." It is beyond doubt that the attendance will be very good, and it is also a fact that the Masonic gathering at Washington (brought to a close last week) will have a good effect in increasing the number of those who will take part in the Baltimore sessions.

Will there be a Suit?—In accordance with the terms of the contract under which the Philadelphia Gas Improvement Company installed an auxilliary water gas plant on the Philadelphia municipal gas works site, a committee from Councils has been appointed to confer with the owners, with the object of determining the terms under which the city can purchase the plant. The Improvement Company is willing to sell, but its proprietors are now confronted with the unfavorable fact that, according to the decision of Judge Benedict, in the case of the United Gas Improvement Company *versus* the New Haven Gas Light Company, the complainant in the latter suit is really the owner of the vital portion of the type of works constructed by the Philadelphia Gas Improvement Company for the city—the Hanlon-Ledley system is the one employed. The United Gas Improvement Company has served notice on the Philadelphia authorities that unless the Philadelphia Improvement Company recognizes its rights in the premises, makes restitution for past infringements, and obtains a license to continue the manufacture of gas under the system, a suit for exemplary damages shall be instituted forthwith. Under the New Haven decision, complainant has a long way the best of the argument; but in any event the city of Philadelphia cannot be in any sense a sufferer, since the Philadelphia Improvement Company guarantees it from any loss on whatever account. We have no doubt, though, that the action will end amicably.

The Trustees of the Hamilton (Ohio) Municipal Gas Works are again in the market for gas works materials. This time they want figures on one multitubular condenser, one impact condenser, one washer-scrubber, one exhauster, and two boilers. Separate bids on each article must be submitted, and the competition will close at noon of the 29th inst.

The Hollidaysburg (Pa.) Light and Heat Company has been chartered by Messrs. J. K. McLanahan, W. J. Woodcock, J. A. B. Melvin, A. S. Morrow and W. P. Smith.

The water gas annex at the Laclede works is to be doubled up. In other words, when the duplication shall have been made the Company can easily turn out 800,000 cubic feet of water gas per diem.

The Brooklyn situation begins to take on symptoms of liveliness. Unless all signs fail it will grow livelier.

Correspondence

[The Journal is not responsible for the opinions expressed by correspondents.]

Uniform Them.

New York, Oct. 9, 1889.

"Sioux City, Iowa, Oct. 2.—Two men entered the jewelry store of Wm. Hiles last night. One of the men asked to be shown spectacles. Mr. Hiles handed out the spectacles tray. He noticed the other man and thought he was the gas meter reader, and when he stepped between the window and showcase Mr. Hines paid no further attention to him. When he had concluded the sale of spectacles, Mr. Hiles, to his dismay, noticed that a tray containing $2,500 in diamond rings was missing."

For some unknown reason the average American, be he native or adopted, objects to wearing a uniform, except a military or society one.

Our adopted female citizen also kicks against wearing the nurse's cap and apron.

It is not many years since the only uniform of our police was a high hat and a star on the breast, and those of us who are old enough can remember what a kicking time there was among them before they consented to wear a uniform.

These remarks are called forth by a perusal of the newspaper clipping given above.

The car conductor has a uniform, or at least a part of one, so that no one else can personate him and collect the fare.

Is there not a greater reason for uniforming the man who takes the index of the gas meter? He should at least have a uniform cap. The "pretended gas man" has confiscated the property of others before, and will continue to do so until a change is made; the only wonder is that this game is not played more often.

No doubt the index man would also kick and complain like the others that a uniform was a "badge of servitude," as if servitude were slavery, which is not the fact. Honest labor is honorable, whether it is performed in a uniform or not.

Identification.

(Continued from p. 476.)

Instruments for Measuring Radiant Heat.

By C. V. Boys, F.R.S.

Improvements in these instruments have been made by placing the bulb of a thermometer in a cavity maintained at a constant temperature, so that the rate of cooling may be more regular; but as my object in these lectures is to deal rather with instruments of a far more delicate order, I shall not say more on this part of the subject. But perhaps it may be worth while to give the figures that have been obtained for the sun's radiation. The quantity of heat which reaches the earth yearly would be sufficient to melt a layer of ice about 100 feet thick spread over the surface of the earth, and the quantity leaving the sun by radiation is sufficient to melt, every hour, about 2,000 feet of ice over the whole surface of the sun.

When we make use of the expansion of a gas, we at once have the means of observing far feebler effects than are possible with liquids and solids; in fact, it is possible to produce an instrument in which the expansion of a gas indirectly shows the presence of radiation which rivals any of the modern thermo-electric apparatus in delicacy, though not perhaps in ease of application.

The first advantage gained by the use of gas is the small weight and the great rate of expansion with rise of temperature. Air expands far more than alcohol; at ordinary temperatures it has a specific heat far less than that of alcohol, and its density is $\frac{1}{770}$ of the density of alcohol. Thus a given quantity of heat applied to a certain volume of air would produce an expansion for each of these reasons greater than it would do if applied to the same volume of alcohol; but as the capacity for heat of the containing bulb, in the case of air, is everything, while in the case of alcohol it is practically nothing, the differences are not quite so great as would at first appear. Still, in spite of the weight of the thin glass bulb, the rate at which the bulb of air is heated is enormous compared with that at which the same bulb of alcohol would be heated, and so it comes to its final temperature far more quickly than would any liquid, and then when it has done so, the expansion is far greater. The expansion of air at constant pressure is most easily found by using a special scale of temperature obtained by adding the figure 273 to the temperature, as measured by a centigrade thermometer, and calling this the absolute temperature, then the volume is proportioned to the absolute temperature, if the pressure is constant, or the pressure is proportional to the absolute temperature if the volume is constant. Thus if we make an air thermometer with a bulb 2 inches in diameter, and a tube $\frac{1}{10}$ of an inch in diameter in the bore, the bulb has a capacity of 533 inches of the tube, and therefore the degrees will be very nearly 2 inches long. The air thermometer, consisting simply of a bulb and an open stem containing an index of some liquid, is a very inconvenient instrument, because every change in the pressure as shown by a barometer will produce its own effect; thus, if in the case taken the barometer were to fall 1 inch, from 30 to 29, the index would move more than 18 inches from this cause alone. For this reason, and also because in measuring radiant heat we want to observe the increase in temperature, and not the actual temperature, Leslie's differential air thermometer is more suitable. This simple instrument consists of a tube bent into the shape of a U with a bulb at each end, and with liquid filling half the tube. This instrument is rather less sensitive than the simple air thermometer, because in working it sets up a pressure due to the difference of level of the liquid in the two limbs which tends to compress the air where it is expanded, and to make it expand where it is contracted; further, the bulb not exposed to the radiation has the air in it compressed by the expansion of the air in the warmer bulb. The first of these opposing causes is removed in Rumford's differential thermometer, in which the horizontal limb of the U is very long, and the vertical legs short. The short index of liquid in moving along the horizontal tube does not set up any opposing hydrostatic pressure. With the first of these instruments Leslie made his researches on radiant heat before the thermopile had been invented, and as is so often the case with the true experimentalist, he thus made his most famous discoveries with the simplest possible means.

A modification of the differential thermometer has been devised by Prof. H. F. Weber, of Zurich, of which a very short account is given in the "Archives de Geneve," 1887, p. 347; so short, in fact, that it is impossible to criticise the instrument until more details have been published.

In this instrument, which Professor Weber calls a microradiometer, the two bulbs of a differential thermometer are replaced by two thin boxes of brass, one end of each of which is made of a plate of rock salt. These boxes are joined to the two ends of a glass tube with a bore about 1 square mm. in area, which has a small bulb blown near each end. The middle of this tube is filled with mercury, and the bulb and about 5 mm. of the tube at each end are filled with a solution of sulphate of zinc, which is prevented by capillarity from escaping into the boxes. If one box is warmed more than the other, then, as in the ordinary differential thermometer, the liquid in the tube is driven a small way towards the other bulb. The peculiarity of the instrument depends on the way in which this motion is made evident. The 5 mm. or so of sulphate of zinc solution between the bulbs, and the mercury in the tube at each end, form two of the arms of a Wheatstone's bridge; the other two arms consist of a pair of resistances as usual, which are put into electrical connection with the sulphate of zinc solution by wires sealed into the bulb. When, owing to the warmth of one of the boxes, the column of sulphate of zinc is lengthened in one end of the tube and is shortened in the other end, the resistance of the one end is increased and that of the other diminished, and thus there is a double disturbance of the balance of the bridge, which at once makes itself felt in the galvanometer.

With this complex apparatus Professor Weber says he can detect a 100-millionth of a degree, and that the heat of the moon produces an oscillation of about a hundred divisions of the scale.

I can only conclude, from the very short account at present published, that this instrument is very sensitive, far more sensitive than anyone would suspect; but whether the indications given by the instrument bear any direct relation to the increase of temperature of the boxes, there is at present no evidence to show. The inventor gives as the theory of the instrument that it is a simple Wheatstone bridge, and that the change of resistance of the arms is the cause of the want of balance. I am inclined to think that this must be very much involved with another action that must certainly come into play. When one of the boxes is warmed, the liquid is driven from that side, but if the increase of temperature—and therefore the acting pressure—is very small, the liquid will not simply move along and take a new position; the ends of the column of mercury will certainly move irregularly, and will also change in shape to a slight extent. Owing to the change of shape electro-capillary action will be set up—that is, an electromotive force will be set up independently of that due to the battery, which will affect the galvanometer if the bridge connections are so made that the galvanometer is connected with the two bulbs; whereas it should produce no effect—or but a slight effect—on the deflection if the galvanometer connects the mercury thread and the two resistances. Which arrangement is made, the paper does not show. It is very difficult to believe that each 100-millionth of a degree by which one box is warmed will produce the proper motion of the liquid due to it. The pressure that this temperature represents is about one 30,000-millionth of an atmosphere; that is a pressure of 1,000-millionth of an inch of mercury, or a pressure of about 100-millionth of an inch of water.

The experience of most physicists is, that in a capillary tube with four separate capillary surfaces, such a pressure would not cause any real movement of the liquid as a whole. It is easy to understand that in the case of larger differences of temperature the effect produced will be so enormous that, if all went in proportion, the 100-millionth of a degree could be detected; just as in the ordinary wheel barometer—in which the motion of the mercury is greatly magnified—the index would be capable of showing, if all went in proportion, thousandths or perhaps ten-thousandths of an inch, whereas everyone knows that in this case you can, by judicious tapping, make the index rest in a variety of positions. I do not wish to be understood to say that this is the case with Weber's instrument, but only that this is what anyone would expect. It is to be hoped, therefore, that we shall have details before long which will set these doubts at rest.

The air thermometer referred to so far may be classed among statical instruments. They come to rest when a certain definite change of temperature has been produced, and the position of the index is a measure of that change or difference of temperature.

There is another way in which the expansion of a gas may serve to indicate change of temperature. When a gas—air, for instance—is warmed, and therefore caused to occupy a larger space, the density of the gas, of course, becomes less. The gas, being lighter, rises, and produces the well-known rising current of hot air to which I drew your attention at the beginning of this lecture. These air currents are only too well known to the experimentalist. If, in weighing anything—a crucible, say—the thing being weighed is not quite cold, it warms the air round it and sets up a current of air which altogether disturbs the balance, and makes the thing seem too light. If the sun shines upon one end of the balance case it warms it and sets up air currents which again disturb the equilibrium. A gas burner near the balance will do the same thing. Cavendish found, in that famous experiment by means of which he found

the mass of the earth—*i. e.*, the number of tons of material which go to make the earth—that a difference of temperature produced by definite means, but still probably too small to be shown with a thermometer, produced disturbances which altogether masked the effect which he was measuring, and these disturbances were simply caused by air currents. The Rev. A. Bennet, F.R.S., in a paper of very great interest, and which is very refreshing in these days of centimeters, grammes and seconds ("R. Soc. Trans.," 1792), shows how air currents set up in this way may be used to detect the most extraordinarily feeble radiation. I give his own account of his fifth experiment:

"Several other light substances were suspended by fine spider threads and placed in a cylindrical glass about 2 inches in diameter, as the thinnest part of the wing of a dragon-fly, thistle down, and the down of the dandelion; of these the last appeared the most sensible to the influence of heat, for when the down was fastened to one end of a fine gold wire it would turn towards any person who approached at the distance of 3 feet, and would move so rapidly towards wires only heated by my hand, as very much to resemble magnetic attraction."

Again, Mr. Crookes, in some of his researches, when great accuracy was required, was obliged to place his balance in a vacuum, and then, curiously enough, other irregularities were observed which led him to examine in greater detail what happened when radiation fell on light suspended bodies. He found, as had been found before, that these things appeared to be attracted by the influence of radiation. They were really warmed, and the current produced caused the appearance of attraction. On trying the same experiment under diminished pressures this apparent attraction after a time ceased, and then when the vacuum was sufficient, repulsion was observed instead. In this way he was led to the invention of that marvelous instrument, the radiometer, and afterwards to the discovery of those extraordinary effects due to what he called radiant matter. I do not know whether I ought not to include the radiometer and several other of Mr. Crookes' pieces of apparatus in the catalogue of instruments for measuring radiant heat. They certainly do measure in a way; in fact, in one of his tubes Mr. Crookes arranged a torsion balance, by means of which he actually weighed the repulsion due to a certain beam of light. The subject of his instrument is itself so vast that I really dare not enter upon it, and I think I am justified, for radiometers do not, as far as I know, supply convenient means of making accurate comparisons of feeble degrees of radiation.

There is no end of the number of instances that might be given of the effect of air currents produced by even feeble degrees of radiation. Every experimentalist must have met with many instances. Though the effects are so strongly marked, I do not think much has been done to make use of these currents to measure radiation. There are the experiments of Mr. Bennet and Mr. Crookes, already referred to; there is also an instrument devised by Joule, and described in the first volume of his papers published by the Physical Society, p. 535, which I cannot do better than describe in his own words:

"A glass vessel in the shape of a tube, 2 feet long and 4 inches in diameter, was divided longitudinally by a blackened pasteboard diaphragm, leaving spaces at the top and bottom each a little over 1 inch. In the top space a bit of magnetized sewing needle, furnished with a glass index, is suspended by a single filament of silk. It is evident that the arrangement is similar to that of a 'bratticed' coal-pit shaft, and the slightest excess of temperature on one side over that on the other must occasion a circulation of air, which will ascend on the heated side, and after passing the fine glass index, descend on the other side. It is also evident that the sensibility of the instrument may be increased to any required extent by diminishing the directive force of the magnetic needle."

I have made and now show an instrument of this class, in which the vane consists of a fragment of straw suspended by a quartz fiber one ten-thousandth of an inch in diameter. The arrangement is so delicate that it is in this form quite unusable, but it would seem, as it did to Joule, to be capable of being developed into a serviceable instrument.

Both Joule and Weber make use of the moon to show the extreme sensibility of their inst ument. It was long a question whether any heat was sent to the earth from the moon. Prof. Tyndall, in speaking of this heat, says: "Concentrated by a polyzonal lens more than a yard in diameter upon the face of his pile, it required all Melloni's acuteness to *nurse* the calorific action of the moon up to a measurable quantity." I shall return to the moon's heat in another lecture, and show that this is not really a fair comparison; but it is, I hope, sufficiently evident that by means of the air current itself it is possible to detect effects of heat so feeble in amount that nothing but the most delicate apparatus would be thought capable of making their existence evident.

Lecture II.

In the first lecture I dealt with the subject of instruments which show the effect of heat by the expansion of something, whether a solid, a liquid or a gas, and showed that while in general these instruments are not capable of showing very feeble effects, yet three of them—Edison's tasimeter, Weber's microradiometer, and Joule's convection thermometer—are, according to all accounts, much more sensitive to the influence of radiant heat than we should be led to expect if we consider the very small co-efficient of expansion of bodies for heat. In two of these instruments a change of electrical resistance is the indirect result of the increased temperature of the part of the apparatus exposed to radiation, and in these cases the sensibility simply depends upon the sensibility of the galvanometer that is used in conjunction with the apparatus.

The second class of instruments to which I referred in the last lecture, instruments depending on thermo-electromotive force, are of two kinds, those in which there is a fixed thermo pile or thermo-junction which sends a current when it is warmed round the needles of a galvanometer, the deflection of which is a measure of the heat poured into the instrument; and, secondly, those in which the thermo-electric circuit is suspended in a strong magnetic field, in which it tends to turn round when a current is sent round the circuit in consequence of the heating of the junction.

The third class of instruments to which I referred are those in which heat changes the electrical resistance of a conductor which is exposed to the radiation, and in which the change of resistance is observed—as in the case of the tasimeter—by means of a galvanometer, either arranged differentially or with a Wheatstone's bridge, so as to obtain the greatest delicacy possible.

All these instruments for measuring radiant heat, which are of an electrical character, require the aid of a galvanometer, or in a few instances they act as their own galvanometer; but in every case they require that a suspending fiber of some kind shall be used, since no pivots that can be made are so devoid of friction as not to completely destroy all chance of observing those minute effects which are within the grasp of the experimentalist.

Since this subject of suspending fibers is of the first importance in nearly all instruments of precision, not only in those which form the subject of these lectures, and since the fibers that are at present in common use all are subject to defects of a very serious character, I feel that I shall not be giving too much time to this part of the subject if I devote the whole of this lecture to its consideration, more especially as I shall be able to show that the annoyance to which the physicist is constantly exposed, owing to the vagaries of his silk suspensions, is no longer a necessity, and that the limit of accuracy which in many cases is due to the same cause, no longer is determined by the uncertainty of the suspending fiber, but by other causes which, in the presence of silk, are of no account. I shall, therefore, treat this subject of suspension on rather broader lines than I would do if I were merely considering galvanometer construction.

Of all the means that we possess of measuring minute forces, the torsion of a wire or thread is more convenient than any other; because no matter whether the force to be measured is a mere pull, as in the case of an attraction, or a twist, as in the case of a magnetometer or electrometer needle, torsion may be used, as in the first case, the pull may be applied to the end of an arm carried by the torsion thread, and in the second the turning force or moment may be applied direct.

By means of the torsion of an ordinary piece of brass or German silver wire, a foot long, and as much as 1-50th of an inch in diameter, forces as little as the weight of a single grain can be made evident to an audience. For instance, I have a straw suspended from such a wire, on the end of which I have placed a fragment of sheet iron weighing 10 grains. A weak magnet is incapable of lifting the piece of iron, yet it is able to pull it round through a large angle, and therefore to twist the wire to the same extent. One-tenth of this movement of this straw would be visible to everyone in the room, and therefore a force as small as the weight of a single grain, a force which to our senses is inappreciable, can be made evident with wire as thick as this. If, instead of a plain straw, turning round over the table, we had a fine index passing over a scale, or, better, a mirror reflecting a beam of light on to a scale, then it would be possible with the same wire to observe the effect of a force a hundred or a thousand times less.

With a finer wire, as is evident, feebler forces may be measured, but it is not at once evident to what extent a fine wire, say, one-half the diameter, will be more sensitive. If the wire has half the diameter it will be sixteen times as sensitive, because $2 \times 2 = 4$, $4 \times 4 = 16$; and so for any other number. The torsion varies as the fourth power of the diameter.

Now going back to the experiment in which it was shown that with a wire one-fiftieth of an inch thick the torsion was sufficiently small to make it possible to measure forces which to our senses are quite unobservable, forces of one-hundredth or one thousandth the weight of a grain, it is evident what an enormously-increased delicacy would be obtained by using a wire, say, of one-tenth the diameter—and still finer wire than this can be obtained in any quantity. In this case, since $10 \times 10 = 100$, and $100 \times 100 = 10{,}000$, the force that would be required to produce a given twist in the thinner wire would be 10,000 times less than is necessary in the thick wire; therefore forces as small as one millionth or one ten-millionth of the weight of a grain would with this simple apparatus be observable.

[To be continued.]

The Hamlin Gas Enricher.

Letters Patent (No. 411,809) were granted on the 1st inst. to Europe W. Hamlin, of Wilmington, Ohio, for claims on new and useful improvements in gas enrichers. In his specification the inventor asserts that his efforts have tended to an improvement in apparatus for manufacturing gas for the purpose of liberating from the tar produced in the manufacture of gas the more volatile hydrocarbons contained in it, and mingling them with the gas, thereby enriching it and increasing its candle power as well as quantity, and also of dissolving and utilizing the surplus naphthaline produced with the gas.

It is well known that the tar produced in the manufacture of gas contains hydrocarbons in greater or less quantities; but no means has yet been discovered for effectually liberating them, for the reason that the heat required to cause the requisite disintegration of the tar causes the tar to pitch or become hard and solid, after which it is no longer capable of the necessary manipulation.

Having discovered that when the hot liquid tar coming from the gas works is heated to a still greater degree by live steam being passed through it from the bottom or near the bottom in such a way as to keep the tar in motion or a boiling condition, caused by ebullition of the steam passing up through it, the inventor claims that he can prevent the tar from pitching, while the heat causes the liberation of the hydrocarbons, which mingle with the gas and enrich it. The device for carrying out this process has been arranged as shown in the accompanying drawings and description.

In practice the gas passes from the retorts to the hydraulic main, when the tar and ammonia water is partly precipitated, the gas passing on to the gas main, carrying with it a small quantity of tar and ammonia water which has not been precipitated. The gas is forced through the main by means of a current caused by a rotary or steam-jet exhauster, into what is called the "scrubber" or "washer." By passing the gas as it comes from the exhauster through a vessel containing hot liquid tar, and introducing with the gas live steam, so that the gas and steam enter the tar and rise through it, causing a boiling or ebullition, keeping the tar in motion, the hydrocarbons in the tar are liberated and taken up with the gas without pitching or solidifying the tar. In ordinary gas there is at times an excess of naphthaline, which is apt to crystallize and clog the pipes.

More or less hot water accumulates in the tar chamber, which acts upon the gas, dissolving any surplus naphthaline or reducing it to a more volatile form, thus preventing its crystalization and separation from the gas. The accompanying drawings illustrate the best form of device or machine for accomplishing this end.

Fig. 1 is a side elevation of the machine (which is called the "enricher"), shown partly in section. Fig. 2 is a sectional side view of one end, showing a modified form of the bye-pass valve or regulator. Fig. 3 is a cross section taken through the lines *X X*.

The enricher is designed to be attached to the gas main of any gas works between the exhauster and washer or scrubber, and can be inserted by cutting away a section of the main at that point and inserting the enricher in place of the section of pipe taken away.

Like letters of reference indicate identical parts. *A A* is the main leading from the gas works conveying the gas and steam to the washer, a section of it having been removed for the insertion of the enricher. *B* is an iron vessel or boiler of any convenient shape (shown in the drawing as cylindrical). The main *A* enters this chamber at one end and extends almost to the opposite end. The lower side of this portion of the main *A* is perforated, and the perforations open into small pipes *c*, extending downward into the tar. These small pipes may extend almost to the bottom of the chamber *B*, or may be omitted altogether if the supply of tar is kept above the openings from the main, or if the flow of the gas has sufficient force to drive it down into the tar.

The open end of the main *A* inside the chamber is provided with a bye-pass valve *C*, with a valve-rod *C'* extending outside the vessel.

In Fig. 2 *D* is a modified form of valve, and *D'* the valve-rod. When the valve *C* is closed, the gas, mingled with hot steam, is forced down through the tubes *c* nearly to the bottom of the chamber *B*. Where a rotary exhauster is used, steam must be introduced from a boiler. If a steam-jet exhauster is used, no additional steam is needed.

Fig. 1.

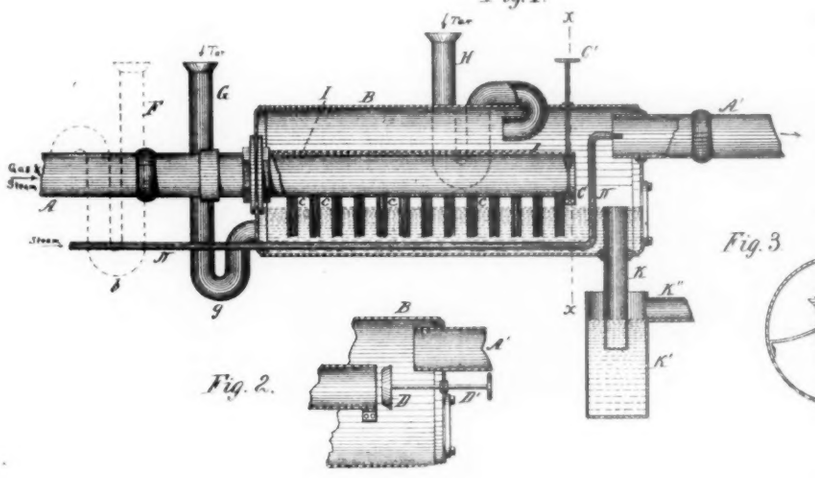
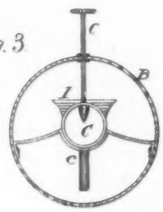


Fig. 2.

Fig. 3.



The chamber *B* is kept partly full of tar, conveyed to it from the gas works, there being also more or less ammonia water carried with it. This tar may be introduced in various ways, as shown in the drawings. It may be introduced directly by the pipe *G*, which is curved downward before it enters, as at *g*, so as to form a seal to prevent the gas from escaping; or the tar may be introduced into the main by the pipe *F* when it flows into the enricher along with the gas and steam; or, again, the tar may be introduced by the pipe *H* above the main, in which case it flows into a pan on top of the main (indicated at *I*, Figs. 1 and 3). This is a shallow pan extending along the top of the main and partly down its sides, so as to cause the tar to hug the main and spread over it as it flows along to the inlet end of the chamber and then down over the sides of the main to the bottom of the chamber, and thereby become heated to a greater degree. The tar flows out by the overflow pipe *K*, which extends down into the vessel *K'*, in which is kept a sufficient quantity of tar to form a seal. The pipe *K* is arranged with screw threads, so that it may be raised or lowered to regulate the quantity of tar in the chamber *B*. In the drawings the pipe *N* is such a pipe discharging into the main *A'*, where it serves also as an exhaust to increase the current or flow of gas through the chamber.

The following is the mode of operation: The valve *C* being closed, the gas flows in through the main *A*, mingled with steam. It is then forced down through the pipes *c* to the bottom of the chamber *B*, and then comes up through the hot tar and passes out through the main *A'*

to the washer. If preferred, the tar in the chamber *B* may be kept above the bottom of the main, and the pipes *c* be shortened or omitted. The gas and hot steam passing through the heated tar cause a partial decomposition and disintegration of the tar, by which the hydrocarbons contained in it are liberated. These are taken up by the gas, and serve to greatly enrich it, increasing its candle power many per cent., besides increasing the quantity of gas produced. The tar, by being kept thus agitated is prevented from pitching by reason of the heat. The hot ammonia water, with the tar, aids in purifying the gas, and the heat and moisture prevent the precipitation or separation of any naphthaline from the gas, which would both impoverish the gas and tend to clog the pipes.

It may be desirable to heat the tar more effectually than is done in the manner above described. This may be done by carrying a steam pipe through the tar. The gas after passing from the enricher, as described, goes to the washer through the main *A'*, where it is treated in the usual way.

Some Reflections upon the Commercial Policy of a Gas Undertaking.

By J. Carter.

[A paper read before the Eastern Counties Gas Managers' Association, England.]

The industry with which we are connected, in its commercial aspects, is receiving in these days more attention, and is the subject of thought to a greater extent than was formerly the case. Gas engineers and managers are discussing matters of business policy as well as the subjects of a technical character. This is a hopeful sign. A sound commercial policy is a necessity to the full development and success of any business undertaking, and to the gas industry no less than others. And in these days, when the spirit of competition is abroad, it is a matter of great importance that we should carefully inquire as to what are the best principles which can be applied, and having determined upon them, then, as far as we are able, secure their adoption.

The lines to be laid down for the conduct of our business must necessarily be largely influenced by the competition which gas has to encounter. I need not stop to make any reference to electric lighting as a competitor with us, beyond this, that it is never wise to despise a rival, and even the presence of electricity amongst us as a lighting agent will do us no harm if it quickens our energies, and leads us to the adoption of principles of business which will establish gas more firmly in the public favor. The only competition which comes into close quarters with us is that arising from the use of petroleum. In some towns this is keenly felt. In Lincoln, with gas at 2s. 6d. per 1,000 cubic feet, there are from two to three thousand houses where petroleum, or illuminants other than gas, are used. And I do not suppose that this proportion is greater, nor as great, than obtains in some other places.

Now, the important question to every one of us is, what is the line of conduct to pursue in the face of these circumstances in order that we may maintain the pre-eminence of gas as an illuminant, and extend its use still further.

I cannot improve upon the suggestion made by a gentleman whose name is always received with favor in a gathering of gas managers—I refer to Mr. Thomas Newbigging. He stated, as the points at which gas managers should aim, cheapness, lighting power, purity, and the removal of every hindrance which stands in the way of the more extended use of gas for lighting and cooking purposes. If we can succeed in the attainment of such objects as these we shall do much, probably all that is necessary, to the full development of the business with which we are all associated. With regard to cheapness: There are many things in connection with the manufacture of gas which affect the selling price. The careful selection and purchase of coal; the best and most economical methods of carbonization; the most profitable means of disposing of the residual products—all have an important bearing upon this question. There is one other factor in the case, and not the least important, viz., the annual charges for dividend and interest. It is not too much to say that the capital charges have in all cases a great deal to do with the price charged, and in some it is the determining factor. I have here a few interesting figures upon this point, most of them relating to gas undertakings in the district covered by this Association, and showing what proportion of the selling price of gas is absorbed by the annual charges on account of capital:

1.	Capital charges	per 1,000	cubic feet	10d.
2.	"	"	"	10.77
3.	"	"	"	14.26
4.	"	"	"	18.46
5.	"	"	"	19.16

It will be observed that between the highest and the lowest of these there is a difference of no less than 10d. per 1,000 cu. ft., or nearly so, and this means, other conditions being equal, that in one case gas can be sold at 10d. per 1,000 cu. ft. less than in the other, where the capital charges are so much heavier. The moral of these facts then is, keep the capital account down to the lowest point possible. The cost of absolutely new works, extensions, properly so called, are of course legitimately chargeable against the capital account, but it may be the case that expenditure of this class has not been so carefully watched as it would be if it immediately affected the profit and loss balance. We shall do well to remember that every £100 spent upon this account imposes a perpetual tax of £6 or £7 per year, according to circumstances, upon the undertaking. Heavy capital charges render cheap gas an impossibility. A manager who has to pay 19d. or 20d. per 1,000 cu. ft. away in shareholders' dividends has a heavy burden to carry, and however attentive to, and skilful in his business he may be, the result of each year's work is to a great extent spoiled.

There is another point in connection with this matter. In raising new capital as required, why should not gas undertakings take advantage of the cheapness of money as other commercial concerns do, and obtain a larger proportion than now is the case, in the way of debenture or other stock at a low rate of interest. There should be no difficulty in the way, considering the security which we can offer. Gas capitalists may reasonably be expected to recognize the altered condition of the money market, and be satisfied with 4 or 4½ instead of 6 or 7 per cent. as formerly. This would all tend in the direction of cheap gas.

The advantages accruing from a low selling price are obvious enough to all. It generally means a growth in consumption, and affords a manager an opportunity of extending his business as no other circumstance will. This is general experience. One necessary feature of our policy, then, is to aim at cheapness. Another is to supply gas of high illuminating power. A Parliamentary standard is by no means the only consideration that should influence us. It may be low, and generally is, in many cases not more than 14 or 15 candles; and although this may be legal requirement, policy suggests that a higher standard should be attained. It is unwise for any manager to be satisfied so long as he just complies with this modest Parliamentary requirement. In that case a low standard becomes a very doubtful advantage. A more liberal policy in this particular is far better. It is not for me to say what should be the lighting power of gas supplied, but I will venture to assert that, with our present knowledge of coal, and our extended experience as to the best means of condensing, cleansing and purifying, an average photometric power of 16½ to 17 candles should not be beyond our reach, and the quality should be, all things considered, as uniform as possible. In short, our efforts should be directed to satisfy our customers. Of course, we do not expect an immunity from complaint under any circumstances, and we shall probably find that the loudest complaints come from those who have the remedy in their own hands. But in the main, the supply of a good material yields satisfactory results, and there is no reason to suppose that gas provides an exception. Very much the same remarks will apply on the question of purity. Generally speaking, our customers mean sulphur when they talk of impurity, and probably, even after all the attention which has in recent years been given to the question of the elimination of what are known as the sulphur compounds, in some few cases the complaints are not without just cause. I recollect reading a letter, I think in the *Gas Journal*, in which the writer showed how small a proportion by volume was represented by 40 to 50 grains of the sulphur compounds per 100 cu. ft. But that is not the question. Are the 40 or 50 grains an irreducible quantity? We all know that it is not so. I am acquainted with a gas works where, some years ago, oxide of iron was the only material used in the purifiers, and the result was gas containing an average of about 40 grains of sulphur. Upon using lime in conjunction with oxide, and still working the same number of purifiers, these compounds were reduced to an average of 16 grains, and the additional cost was represented by a fraction of 1 penny per 1,000 cu. ft. of gas made. The small additional outlay was well spent in removing the cause for reasonable complaint, and whatever can be done in this direction, it is surely to our interest, commercially considered, to attempt.

There yet remains another question—viz., what is to be done to make gas available to the masses of the people to a greater extent than it now is? This, I think, may be done partly by abolishing what I regard as unwise restrictions which, in practice, have been placed in the way of its more extended use in the form of charges for laying services and fees for fixing meters. I would put in all services, irrespective of distance (up to the limit which legally entitles a person to demand a supply of gas), without making any charge whatever, provided there is no private ground to pass through. Meters should be fixed free. I have heard of

a company charging a fee of 2s. 6d. for each meter they were asked to supply. I cannot understand such a charge being made. It appears to me to be without reason. I would make a clean sweep of all such charges.

The exaction of deposits from consumers is another practice which should be abandoned. It has been said that in dealing with the working classes it is necessary to demand a deposit, as a protection from loss, before giving them a supply of gas. My experience proves that the precaution is altogether unnecessary. In the case of Lincoln, out of a total number of 5,500 now in use, 4,000 are 3-light meters. A large proportion are fixed in the dwellings of the working classes, and we have no customers, speaking generally, who pay their accounts more regularly, or who give us less trouble. It may be safe to require a deposit; there will be some few cases where it will be necessary to do so, but I think it is the wiser policy, and one more conducive to the extension of our business, to abandon the practice altogether, and rely upon a prompt and efficient collection of the accounts.

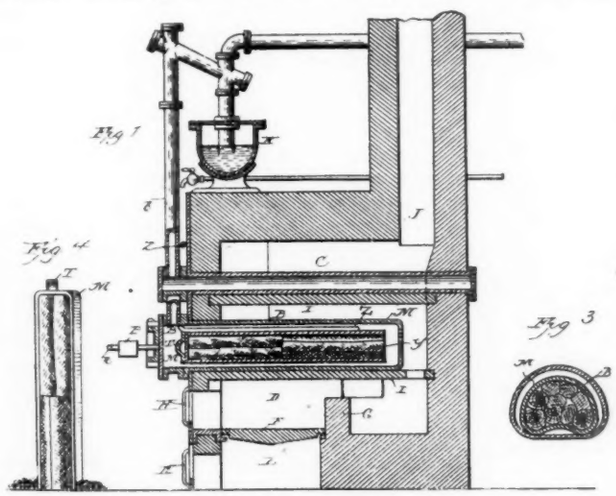
It is said that the charging of meter rents is a great hindrance to the extension of the business. I am not sure that this is generally the case, and I am not prepared to say that no rent should be imposed. I do not think that the charge, provided that it be a reasonable one, is open to objection upon principle, but if I were satisfied that it operated injuriously, that it was generally regarded by the consumers, and by those who might become consumers, as an obnoxious impost, I should not hesitate, as a matter of policy, to advocate its abolition. It is a matter which must, in every case, be determined by local circumstances.

The best means of increasing the facilities for the use of gas, especially in the dwellings of the working classes, is a very important matter to consider. It yet remains to be proved whether this can be effectively done by letting fittings out on hire, or selling them on a system of deferred payment, or by the adoption of a prepayment meter which will enable gas purveyors to meet, in a more convenient manner than at present, the demands of the smaller consumers. Experiments in this direction will no doubt be observed with interest. In my opinion, the most hopeful feature of our business is the extending use of gas for domestic purposes. How best to encourage and develop this is a matter of sufficient importance to form the subject of a special paper.

I have laid my views before you with some diffidence, partly for the purpose of exciting an interesting and instructive discussion, but mainly because I am firmly convinced that the adoption of principles I have indicated will prove to be the best policy, and will tend to strengthen and consolidate the industry with which we are connected.

The Averell Process and Apparatus for Manufacturing Wood Gas.

Letters Patent (No. 411,850) were granted on October 1st to John D. Averell, of Brooklyn, N. Y., for improvements in apparatus for the manufacture of wood gas. In this apparatus (referring to the accompanying drawings), Fig. 1 represents a vertical longitudinal section of a

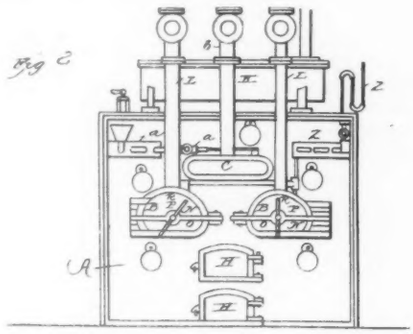


retort bench. Fig. 2 is a front view of the same on a more reduced scale. Fig. 3 is a cross section of retort and cartridge. Fig. 4 is a vertical section of a wood cartridge in position while smothering its contents.

In the drawings A represents a suitable furnace, in which one or more wood distilling retorts B B are employed, and an oil retort C, preferably located above the retorts B B.

D indicates the fire chamber; E the ashpit; F the grate; G the bridge-wall; and H the fire and ashpit doors.

The retorts B and C have beneath them tiles I, for the protection of their bottoms against the intense heat.



The furnace is suitably arched over the retorts to distribute the heat over them, and the top of the rear part of the arch connects with the chimney J of the furnace. The oil retort C passes through the furnace and has suitable lids on each end which can be readily removed for cleaning the retort. The oil for this retort is heated in the heating pipe a, which is arranged partly in the lining of the furnace, and passes the oil several times back and forth in the furnace. Said retort has one central chamber, and one to each side of said central chamber, into which two chambers the oil is introduced from said pipe a, and from thence into said central chamber, from which the oil gas passes by means of the stand-pipe b to the hydraulic main K, located on the top of the bench. The gases generated in the wood retorts pass into the same hydraulic main by means of the stand-pipes L, and all gases contained in the hydraulic main pass through the usual scrubbing process and from there to the holder for use.

The retorts B B have each a suitable mouthpiece N, furnished with a properly-jointed door O, strongly hinged to said mouthpiece, and each door is furnished with a hinged pressure-bar P, carrying the pressure-screw R; and a slotted staple or other suitable fastening is provided for the loose end of the pressure-bar. The retorts may be round or of other shape. The Ω-shape is the preferred, as shown. z represents a steam pipe, which may be connected direct with a steam boiler, or it may be connected with a steam heating or hot water pipe passing through the lining of the retort furnace, as shown in Fig. 2. For each retort such a pipe z is employed, entering at the mouthpiece and passing to the rear or inner end of the retort to discharge a suitably-regulated amount of steam during the process of distillation and to come in contact with the wood.

In each retort for the charge of wood is employed a solid sheet metal wood cartridge M, which has its forward end tightly closed and furnished with a handle T. The rear end of this cartridge is open, and as it is being charged with wood the closed end is held down and the wood inserted from the top into the open end of the cartridge. Relative to the dimensions of the retorts, said cartridge is made smaller to allow the gases generated to pass between the inner side of the retort and over the outside of the cartridge, for which purpose the bottom of the cartridge is made concave to allow a longitudinal passage under it. Said concave portion at the bottom of each cartridge and over the bottom of each retort forms a very hot space, through which the highly heated gases pass, thereby fixing the same. By means of the steam pipe z the steam is conducted to the wood and disintegrates and softens the solid matters and extracts the same, and in this way assists beneficially in the generation of the gas. Relative to the length of the retort, the cartridge is made sufficiently shorter to allow plenty of space for the generated gases to escape from the open end of the cartridge into the rear end of the retort, from where the gases pass forward over the cartridge to the mouthpiece, from which they pass into the stand-pipes to the hydraulic main.

The gases passing close to the highly heated retort are superheated and fixed by the same before passing from the retort. Several of the cartridges are usually employed to enable the attendant to have a ready-charged cartridge on hand as soon as required. After the gas is extracted from the wood the retort is opened and the cartridge is quickly withdrawn. A flat cover (not shown) is then placed over its open end, and the cartridge is placed in sand with its open end down (the flat cover having

been removed) to seal said end and exclude the air from the charcoal, so that the charcoal within the cartridge is smothered and saved from consumption and reduction, and consequently is produced in a valuable mercantile condition. The cartridge withdrawn from the retort is immediately substituted by a second cartridge ready charged, and thereupon the retort is closed.

The combination of retort, cartridge, and steam pipe herein shown and described is not claimed in the present application, but forms the subject-matter of a patent granted the inventor Feb. 19, 1889.

The Composition of Uncarbureted Water Gas.

The London *Journal* is publishing an extremely valuable and most entertaining series of papers on the "Chemistry of Illuminating Gas," from the pen of our English correspondent (Mr. N. H. Humphrys, F.C.S.), who, it is needless to add, brings to his subject a great fund of information. The XXVIIIth paper of the series is as follows:

Some particulars of the composition of carbureted water gas, as supplied to the public in America, have already been given; and it will be convenient at this point to exemplify the composition of uncarbureted water gas as actually obtained in practice on a working scale. Although such gas is not luminous in the ordinary sense of the term, yet attempts have been made to render it so by the aid of incandescent burners. For this reason it may be included as a part of our subject. In the accompanying table Nos. 1 to 10 represent samples of gas manufactured by the "Strong" apparatus. No. 12 is from Greene's report on water gas, drawn up for the Franklin Institute, of Philadelphia, and was taken from a Lowe apparatus. The average composition of the gas obtained in regular daily working with Pintsch's apparatus at Essen is shown by No. 13. No. 14 is from a paper published in the last volume of the Transactions of the American Institute of Mining Engineers.

Carbonaceous Material.	Authority.	Per Cent. by Volume.						
		Hydrogen.	Light Carb. Hydrogen.	Carbonic Oxide.	Carbonic Acid.	Nitrogen.	Oxygen.	Air.
1. American anthracite	Professor Moore	52.76	4.11	35.38	2.05	4.43	0.77	.....
2. " "	Vanderweyde	52.30	4.30	39.40	1.40	.....	.....	2.60
3. " "	Wurtz	49.60	5.50	40.80	1.10	.....	.....	2.70
4. English oven coke	Sarnstrom	55.00		40.00	4.00	.....	.....	1.00
5. Swedish bituminous coal	"	59.50		34.80	2.60	.....	.....	3.00
6. Welsh anthracite	"	61.30		31.10	3.60	.....	.....	1.00
7. One part coke, 3 parts dry peat	"	57.00		35.50	7.00	.....	.....	0.50
8. " " 3 " wet "	"	57.10		33.40	9.00	.....	.....	0.50
9. " " 3 " Newcastle	"	57.20		35.00	6.80	.....	.....	0.70
10. Cannel coke dust	Dr. Bunte	50.00		34.50	7.30	7.50	.....	0.70
11. ——	Langlois	49.62	2.17	42.21	6.00	.....	.....	.....
12. Anthracite	Green	44.50	.....	42.10	3.60	.....	.....	.....
13. Coke	Fischer	48.60	0.40	44.00	3.30	.....	.....	3.70
14. ——	Jacobus	52.88	2.16	36.80	3.47	4.69	.....	.....

The practical information afforded by the table will be better understood after consideration of some few experimental researches on the subject. Dr. Bunte gave the results of some experiments with the "Strong" apparatus at the 1880 meeting of the German Association of Gas and Water Works Engineers. He worked with much shorter "runs" than the period advocated by other engineers, the whole occupying only ten minutes, of which six were occupied in blowing up, and four in making gas. Probably the reason of this was that, from the commencement of each run, he found the gas to deteriorate rapidly. In no case did he secure the absence of carbonic acid; and the proportion present increased rapidly, as shown by the following tests:

	1st Min.	2d Min.	3d Min.	4th Min.
1	6.0	9.0	12.2	14.1
2	5.0	9.5	—	13.5

These figures represent the proportion of carbonic acid that was present in samples of the gas taken at one minute intervals from the time of commencing. The average composition of the gas is given in No. 10. To the frequent changes is attributed the presence of so much nitrogen—viz., 7.5 per cent. At the expiration of each blowing up the regenerators would be full of producer gas; and this would pass backward through the furnace and eventually into the water gas holder. The production was very rapid, 735 cubic feet being evolved at each run, or a total of 87,500 cubic feet per day.

Whatever method is adopted for working the system of alternate blowing up and gas making, it appears difficult to avoid the mixing of a certain amount of air and producer gas with the water gas. The regenerator, furnace, and connections must be filled with producer gas or with air at the beginning of each gas making operation, and this must either be displaced, with the loss of a part of the first formed water gas, or be allowed to mix with the same. Bearing this in mind, it is difficult to understand how it is possible to make gas containing such small quantities of nitrogen as that shown by Nos. 4, 6, 7, and 8; and this suggests the suspicion that the large quantities of hydrogen and marsh gas given in Nos. 4 to 9—a larger proportion than that afforded by other analyses—also include the nitrogen.

The conditions which lead to the formation of carbonic oxide, when air or steam is blown through red-hot coke (carbon), although apparently simple, are in some respects obscure. According to some of the best authorities, 1 lb. of carbon in burning to carbonic oxide liberates 4,500 units of heat; or, if burnt to carbonic anhydride, 14,500 units. If the carbonic oxide is burnt to carbonic anhydride, we get 14,500 — 4,500 = 10,000 units. Or, if carbonic anhydride is decomposed, with the formation of carbonic oxide, 10,000 units of heat are absorbed.

If we force an air blast through incandescent coke, the first result is that carbonic anhydride is formed, with the liberation of a large quantity of heat—about 14,500 units per pound of carbon decomposed. Assuming that after this reaction there is a sufficient body of carbon for the resulting gases to pass through, the carbonic anhydride is decomposed, with the absorption of 10,000 units of heat. One pound of carbon would combine with 1⅓ lbs. of oxygen to form 2⅓ lbs. of carbonic oxide. But the 1⅓ lbs. of oxygen would be also attended by rather less than 4½ lbs. of nitrogen. Assuming that the 14,500 — 10,000 = 4,500 units of heat were absorbed by the resulting gases, their temperature would be raised to the extent of more than 20,000°. In practice, however, some of it would be taken up by the carbon, the sides of the furnace, etc. But it is easy to see that with this continual generation of heat, the process is self-acting, and may be maintained for as long a period as required, by keeping up a proper supply of carbon and air. Indeed, there will be an excess of heat; and the gases will leave the generator at a high temperature. The bulk of the gases at 60° F. will be rather more than 90 cubic feet for each pound of carbon decomposed.

But if instead of air we use steam, a different order of operations occurs. One pound of carbon requires for its decomposition into carbonic oxide 1⅓ lbs. of steam. But the steam, as such, is of no use. It must first be decomposed into its elements—1⅓ lbs. of oxygen and ⅙ lb. of hydrogen. To effect this a certain amount of heat must be absorbed or rendered latent. One pound of hydrogen, burnt to water, yields 62,500 units of heat. It can obviously be burnt, and then reproduced by decomposition of the resulting steam, any number of times. At each decomposition of the steam, a quantity of heat exactly similar to that given out on combustion is absorbed. In the course of decomposition into its elements 1⅓ lbs. of water will therefore absorb 62,500 ÷ 6 = 10,416 units of heat. If we admit the water in the form of steam, a part of this heat has already been supplied to it—say 152 × 1⅓ units to raise it to boiling point, and 997 × 1⅓ units to convert it into steam—a total of 1,723 units. Assuming the steam to be admitted at 212°, the quantity of heat required will be 10,416 — 1,723 = 8,693 units. Toward

this quantity, 4,500 units will be supplied by the formation of carbonic oxide as above explained, leaving a deficit of nearly 4,200 units. In practice a greater quantity of heat must be supplied, because the gases escape at a high temperature. This is unavoidable on account of the fact that the generator and its contents must be maintained at bright-red heat, so as to secure the decomposition of the steam and the formation of carbonic oxide.

On account of this absorption of heat during the manufacture of water gas, the process is attended with a gradual reduction in the temperature of the generator and its contents; and hence the necessity for working intermittently. It is necessary to pause at frequent intervals for the purpose of getting up the heat. And there is also the disadvantage that if the temperature falls below a certain limit the water gas is impure, being charged with quantities of undecomposed steam and carbonic acid. So in practice it is the rule to develop as high a temperature as possible in the generator, either by the manufacture of producer gas or, if this is not required, by the complete combustion of a portion of the fuel to carbonic acid.

The bulk of water gas produced by the decomposition of 1 lb. of carbon is about 61 cubic feet at 600° F. To produce this quantity of gas, 4,200 units of heat are absorbed; or (say) 70 units per cubic foot of gas. As we have seen, as much as 10,000 cubic feet of water gas are sometimes formed at one run, which would mean the absorption of 700,000 units of heat, besides that used for the generation of the steam. The specific heat of coke at ordinary temperatures is 0.2; but the specific heat increases as the temperature rises. If we assume it to be doubled at incandescent temperatures, we arrive at the factor 0.4 for working upon. Further, assuming the generator to contain 1,000 lbs. of coke, it will be seen that each increase or decrease in temperature means a gain or loss of 400 units. So that in order to form anything like the above quantity of gas per run, either a very high temperature or a large generator would be necessary. For the purpose of roughly exemplifying the working, let us assume that the *minimum* temperature necessary for the production of pure water gas is 1,800°; and that the maximum temperature obtainable in the generator by the air blast is 2,500°. Assuming that the generator contains 1,000 pounds of fuel, we have then an excess of heat available for making water gas of $(2,500 - 1,800) \times 1,000 \times 0.4 = 280,000$ units. This quantity of heat would be equal to the production of 4,000 cubic feet of water gas. If we depended upon the producer gas for its generation, we should have to make about 5,600 cubic feet of that mixture for each 4,000 cubic feet of water gas; or, if we prefer to burn the fuel completely to carbonic anhydride, about 20 lbs. must be used between each run.

In these calculations it is assumed that the whole of the heat—including that carried off by the gas—is utilized. In practice, some advance towards this result is made, by applying the hot gas to the heating of the water or the steam supplied to the generator. It fortunately happens that the specific heat of steam is high—0.475 at ordinary temperatures—so it can be made the means of conveying considerable quantities of heat to the generator. If we "superheat" the steam to 700° we thus convey $(700 - 212) \times 1.5 \times .475 = 348$ units of heat; or, allowing for the increased specific heat at higher temperatures, we may say 400 units—*i.e.*, or nearly 10 per cent. of the total heat required. In a similar manner the air supply for the producer gas, or the combustion necessary in heating up, may be heated by means of the effluent gases, or, if preferred, by other means.

The heat generated in the production of 5,600 cubic feet of producer gas is about equal to that absorbed in the production of 4,000 cubic feet of water gas. The two gases might be mixed after generation, so as to form a mixture consisting of 30.5 cubic feet of hydrogen, 60 cubic feet of carbonic oxide, and 60 cubic feet of nitrogen. But the same result may be obtained in a simpler way, by admitting a mixture of air and steam in proper proportions to the generator. In this case there will be neither loss nor gain of heat; and therefore the process can go on continuously. The high proportion of nitrogen renders this mixture unfit for carbureting or conversion into illuminating gas; but it can be used as a heating gas, and as such has been put before the public under various special titles.

In the "Lowe" process, as we have seen, the producer gas is burned in the superheaters, and so made to do duty in the way of producing water gas. Various other methods of securing the return of as much of the heat as possible to the generator have also been tried. Or, in some cases, the producer gas may be collected and applied as a fuel to the heating of boilers, etc.

Col. C. F. Spaulding, of the Waltham (Mass.) Gas Light Company, has applied for a patent for a new design of gas stove.

The Measure of Illumination.

In a paper on this subject read by Prof. W. H. Preece, at the Paris Electrical Congress, the author said:

Photometry is the art of measuring the intensity of a source of light, such as an arc lamp, by direct comparison with some known source such as the carcel, bec or British candle taken as unity; but the measure of the illumination of a surface, so far as intensity is concerned, is quite independent of the source of light itself, and it depends only on its distribution. The illumination of the page of the book we read, or of the paper on which we write, or the face which we address, or of the picture we admire, or of the surface of the street on which we walk, varies in intensity whether the source of light which is distributed on these surfaces is the sun, the moon, or combustion, or incandescence of a carbon filament by currents of electricity, or whether it be single like daylight, or multiplied like a well-planned electric light installation.

The standard that I propose is the intensity of illumination produced by a carcel lamp at a distance of 1 meter. This gives excellent illumination on the surface of a book. It is the same illumination as that given practically by a British candle at one foot distance; and thus it assimilates the English and French measures. I call this unit a "Lux," and I find that the illumination on the surface of a street lighted by a single ordinary gas burner is 0.1 lux, while that due to an ordinary arc lamp is 1.8 luces, if the measurement be made at the foot of the pole carrying the source of light.

In determining the illumination of the streets of a town I specify that the light shall be uniformly distributed over the surface of the street, and that the mean illumination shall not be less than three lux, and in the case of a room the light on any table in any part of the room should not be less than one lux, and this can be obtained by an expenditure of energy in glow lamps in the ratio of about ten watts to one square meter floor surface. Hence a table of 100 square meters would take 1,000 watts, or 20 glow lamps of 100 volts and five amperes, or of 50 watts each well distributed to give a uniform illumination of about one lux on the level of the tables.

The measurement of this illumination is very simple. A small glow lamp is placed inside a box, the top of which has a screen of white paper on which is made a grease spot. The illumination of this grease spot on the inside is varied by varying the current incandescing the glow lamp. The strength of this current is the measure of the light. The intensity of the current producing a lux is first determined in the laboratory, and then the illumination of any spot that it is desired to measure is afterwards found by measuring the amperes which cause this grease spot to disappear at that point. A simple calculation based on the law that within limits the lights given by an incandescent carbon filament varies as the I^6 gives the luces directly from the current read on a simple but delicate ampere meter.

Why Mortar Hardens.

Mr. G. R. Burnell says that until very recently it was held by most engineers and architects, by himself amongst others, that the solidification of mortars took place in consequence of the absorption of carbonic acid gas by the lime during the process of crystalization; but it has been fairly objected to this theory that the quantity of carbonic acid gas contained in the atmosphere which could be brought into contact with a large body of cement would not suffice to saturate the latter. The generally received opinion on the subject now is that limes harden simply in consequence of the combination with water which takes place during the slackening, and that the rapidity of the setting, and the permanence of the newly formed hydrate of lime, depends upon its being combined with some other salt; the pure hydrate of lime in fact is soluble, the hydrated silicate of lime is tolerably insoluble, but it forms slowly; whilst the hydrated double silicate of lime and alumina, or of lime and magnesia, are practically insoluble. The facts actually observed seem to confirm these views, and they certainly enable us to account for not only the different modes of setting, observable in different limes, but also for some of the more gradual actions which take place in that material, and the effects reciprocally produced by the mixtures of various ingredients. In the case of the now generally used Portland cements, and in that of under-burnt lime, some very curious phenomena may, however, be observed, which appear to indicate that the simple laws mentioned above do not comprehend all the conditions which may arise; so that the above theory itself must only be considered as a step toward the attainment of a complete one of a more general character. The phenomena to which he thus alludes are connected with the obscure subject of the chemical actions which take place under the influence of high degrees of temperature.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE annual meetings of the Mansfield (O.) Gas and Electric Light Companies were held on Wednesday, October 2, and the reports submitted by the Secretary and Treasurer of each corporation were highly satisfactory to the shareholders. During the meeting the subject of enlarging the gas works plant was informally discussed, and although no positive decision was reached, it is more than likely that next spring the betterment will be carried out. The devising of ways under which a reduction in the selling rate for electric illumination could be made also came up for debate, and the discussion terminated in the verdict that at the current rate for coal in Mansfield, no concession in this respect could be made at present. The annual election for officers in the Gas Company resulted as follows: President, L. A Strong; Vice-President, S. E. Bird; Secretary, W. C. Hedges; Treasurer, Joseph S. Hedges; Superintendent, Geo. S. Harris. The above, together with Messrs. Jno. McIlhenny, Jas. Gardner and J. B. Netscher, comprise the Board of Directors. The election in the Electric Light Company was completed in this manner: President, S. E. Bird; Vice-President, S. E. Uhlich; Secretary, W. C. Hedges; Treasurer, Joseph S. Hedges; Superintendent, Geo. S. Harris; Directors, the above and Messrs. L. A. Strong, Jno. McIlhenny and J. B. Netscher. It is self-evident that the combination which rules the gas and electric light supply of Mansfield is a strong one.

A GERMAN authority recently called attention to the singular deterioration of asphalt pavements in certain sections of the city of Frankfort-on-the-Main, where pavements of this class find high favor with the authorities. Subsequent investigation caused him to decide that the disintegration was chargeable to escapes of gas from the underlying mains.

THE proprietors of the Cohoes (N. Y.) Gas Light Company have installed on their plant a 27½-inch water wheel (horizontal), which, running under 90 feet fall, is calculated under favorable circumstances to produce 400 horse power. The power will be employed in driving their electrical annex. The wheel was manufactured by the Swaine Turbine Manufacturing Company, of Lowell, Mass.

THE Pennsylvania Gas Company (natural gas) has ordered an advance in gas rates in the towns of Erie, Corry and Warren, Pa., and in Jamestown, N.Y., which places are on the direct line of supply. While the present rates are based on a monthly charge (in accordance with a certain schedule of fixtures—such as stoves, grates, etc.—in use), it is an open secret that the next move will be to charge so much per 1,000 cubic feet. In the meantime we might note that the shares of the Pennsylvania Company, which readily brought par a twelvemonth ago, can now be freely purchased at 70 cents on the dollar.

AT a recent meeting of the Oakland (Cal.) City Council bids for lighting the streets were opened. Tenders were made by the Electric Lighting Company and the local Gas and Electric Lighting Company, and after a long wrangle it was decided to award the contract to the latter at its bid of 35 cents per night—2,000 candle power arcs, midnight table.

AT an advertised meeting of the Gate City Gas Light Company, of Atlanta, Ga., many changes were made in the executive management, and the decision was also reached to at once institute an extensive series of betterments, to include additions to both manufacturing and distribution service. The month for the annual meetings was changed to June of each year. The election for officers resulted in the following choices: President, Capt. Harry Jackson—who succeeds Mr. A. R. Stewart; Secretary, Frank B. Warner; Treasurer, Edward C. Lee—Capt. Jackson formerly filled the last-named positions; Manager, Wm. G. Abel; Directors, Harry Jackson, S. T. Bodine, E. C. Lee, W. G. Abel and F. B. Warner.

MR. C. F. SPINNEY has resigned his position with the Amherst (Mass.) Gas Company.

MR. JAS. CARROLL, who secured the contract for the tank work for the holder of the Metropolitan Gas Light Company of Elizabeth, N. J., is meeting with much difficulty in the prosecution of that task. The heavy rains had much to do with retarding the excavation, and the next stumbling-block was a very refractory bed of shell-rock. In the meantime the surrounding residents are complaining that the tank excavation, even at its present depth, is robbing them of their well water.

"TREASURER HARBISON, of the Hartford (Conn.) City Gas Company, has, as most of the fraternity are aware, rather pronounced views on most subjects connected with the manufacture and sale of gas; but I think—and most of your readers will agree with me—that he has always evidenced an inclination to change his opinion when confronted with the fact that his conclusions might have an erroneous basis. For instance, we all remember how pronounced have been his arguments at the Association meetings in favor of an all-round rate for gas, no matter what the quantity used or for what purpose it was used. Experience, however, seems to have led to a change of base on the part of the astute Hartford gas man, who for some time has been selling gas for power purposes at a considerable concession from that charged for an illuminating supply—$1.25 per 1,000 is the rule for the former and $1.40 for the latter, unless I greatly mistake. I also note that some weeks ago you published an item to the effect that Mr. Humphreys, of Lawrence, Mass., and Mr. Harbison took a joint trip West for the purpose of investigating the measure of practical success that is accompanying the manufacture and sale of cheap artificial fuel gas in that section. As I have not seen any further mention of this trip in your columns, I venture to send you an abstract of what is claimed to be Mr. Harbison's opinion as to what he saw at Jackson, Mich. Without making too long a story of the Harbison findings—he seems to have had his eyes open all the time—it seems that at Jackson the principal feature on which success was claimed had been *out of use* for several weeks; but the Company's representatives asserted that in the new plant to be erected at Hyde Park (Chicago) perfect success would be attained, because of new and valuable improvements that would there be introduced. Perhaps these same improvements are to be a feature of the new plant which I understand is now underway at Jackson; but of one thing I am convinced, and that is that uncarbureted water gas made luminous by the interposition of the Fahnehjelm comb or needles burner will in no wise answer satisfactorily as a vehicle for ordinary illuminating service. I shall obtain great pleasure in being proved a false prophet in this respect if future developments lead to the success of this method of producing and selling gas. The fraternity may also take it for granted that Hartford will not be the last city in the country to have a supply of cheap fuel gas, when the problem of how best to lay on and supply the same shall have been solved.—HADDAM."

IN the course of a thoroughly characteristic letter from Mr. Chollar, that clever gentleman writes, among other newsy briefs, "I hope, if the walking continues good, to be at the Baltimore meeting." Let us express the wish that the weather will remain serene. Chollar would be sadly missed from the gathering at the Monumental City.

MR. G. C. TREWBY, sailed for Europe on Saturday, October 5. All of the persuasive arts of Mr. Page failed to induce him to remain over for the American Meeting.

WE regret to have to say that Mr. S. F. Covington, of Madisonville, Ohio, who was a prominent figure in Western gas circles some years ago—in fact he retains his interest in gas matters up to date—is not enjoying the most robust health. He will leave for California on the first prox., there to remain for some months. It is our sincere wish that his trip will result in speedy and lasting benefit.

THE proprietors of the Oakland Gas Light and Heat Company have determined to order a cut in the selling rates. It is likely that the concession will amount to 25 cents per 1,000 cubic feet. The present schedule calls for $2.25.

THE Board of Directors of the United Gas Improvement Company have declared a dividend of 4 per cent., payable to holders of record of 5th inst. It will be ready for distribution to-morrow.

ANOTHER reason for the practice of uniforming all officials of gas works whose duties require their visiting the premises of consumers is furnished from a circumstance that happened in Sioux City, Iowa, on the evening of the 2d inst. At about 7:30 P.M. on that date two men entered the jewelry store of Wm. Hiles. One of the parties (neither acted as though he were known to the other) asked to be shown some spectacles, while the other walked directly to where the gas meter was located. The proprietor paid no attention to the supposed meter reader, but went on with the trade in spectacles. The purchase having been made, party No. 1 walked out of the shop, No. 2 having, after making an entry in a handbook, preceded his fellow-conspirator by some minutes. When closing-up time came Mr. Hiles concluded that the "meter reader" was responsible for the disappearance of a tray carrying diamond rings to the value of $2,500.

THE Gas Committee of the Montclair (N. J.) Township Committee has been empowered to make a contract with the local Gas Company for the

public lighting. The figures agreed on are $21 per lamp per annum for an all-night service (this is to apply to the lighting of Bloomfield avenue), and $19.50 for lamps burning until 1 A.M.

MESSRS. GEO. C. DAVIS (President) and Alfred L. Ripley (Treasurer) have incorporated the Andover (Mass.) Gas Light Company. Capitalized in $20,000.

JOHN E. STOWE has entered suit against the Saratoga (N. Y.) Gas and Electric Light Company for $2,000 damages. He bases his claim on the ground that his "health has been injured by obnoxious fumes from the Company's plant."

IT is understood that gas will be supplied from the new works at Williamstown, Mass., in a fortnight. "Pure naphtha" gas is to be supplied. The guaranteed candle power is to be 70, and the selling rate has been fixed at $6 per thousand cubic feet. It is a pity, as we have had occasion to remark before, that the Williamstown gas supply is not to be of a different nature, and venture the prediction that the process will have to be noticeably changed before success can be attained.

A DESPATCH from Chillicothe, Mo., is to the effect that Judge Davis, of the Circuit Court for the District, has appointed the Hon. W. E. Gunby as receiver for the Chillicothe Gas, Water, and Electric Light Company. This action was taken at the instance of certain Eastern manufacturers, who had obtained judgments against the Company for materials furnished. The liens so far filed foot up at $9,000.

EASTERN advices are to the effect that the Boston Board of Fire Underwriters are considering the matter of reaching a decision respecting the arrangement of insurance risks on buildings wired for electric lighting. Our correspondent adds: "It is generally accepted among fire underwriters that there can be but one of two outcomes to this issue—either that the electric companies contribute to the Board such an amount as to provide for the proper inspection of such risks, or, failing to do so, that the insurance companies will follow out the line of action originally proposed, and advance rates on risks lighted by electric light companies. That the companies will allow the situation to come to such an issue is thought to be improbable; at the same time developments up to this have been in that direction. Should the introduction and use of the electric lights in a building at once enhance the insurance rates upon that risk, the natural result would be a decided set-back to the adoption of electric lighting. But in view of the frequent fires occasioned by electric light wires, it is a fair assumption that their introduction into a building increases the hazard of fire in that risk, unless it can be shown that the work of insulating and wiring had been properly done. Heretofore the electric light companies have, apparently with willingness, contributed to support a number of inspectors acting under the Board as representatives of the insurance companies, and because these inspectors have seen to it that wired risks were properly constructed, have the underwriters refrained from considering such risks extra-hazardous, and rates have remained steady. With the greater activity on the part of electric light companies, however, additional inspectors became necessary to do the work properly, and at this point the lighting companies evinced a disposition to refuse longer to contribute for the maintenance of *any* inspection. On its part, the Board, as the representative of the insurance companies, does not presume to maintain such a department at its own expense, taking the ground that it is no portion of its duty to see that work which concerns the light companies is properly done, that risks lighted by them may receive the minimum insurance rates. It is not the insurance companies that are interested in low rates, though free to offer them whenever practicable; but it is the owners of the real estate and the electric light companies that become directly interested in low rates. The Board is firm in the stand that it has taken; it does not recognize any responsibility in the matter. It practically says to the light companies that if they assure the Board that the hazard in certain risks lighted by them is not in consequence increased, rates will remain as they are; but that unless such assurance is given such risks will be regarded extra-hazardous, and rates will be advanced. The Board assumes that it is a matter that alone concerns the electric light companies, and awaits their decision.—A. F."

A WRITER in the Boston *Post* says: "I must confess to considerable surprise at the report of the number of broken glasses in the street lamps here in Boston, and as such breakage is much too large to be the result of accident, it seems to me that preventive measures may with certainty be taken against it. It has been my impression that the police force of the city was designed to check abuses of this kind, and as the cost of repairing the broken lamps is estimated at nearly $10,000 per annum—these figures, of course, including salaries, cost of glass and labor in resetting, it is certainly worth while to direct their attention to this subject. It appears that May was the month this year when the largest number of panes was broken, no less than 1,945 lights of glass being placed in the street lanterns to supply the loss of the old ones. What there is in this pleasant month beyond the fillip to the spirits which comes with sprouting grass and bursting buds I do not know, but it seems to me high time that this overflow of enthusiasm should be turned into less harmful channels. It is usual to credit boys with a sort of exuberant animation which finds vent in breaking lamps, but one hardly expects to have it burst out in such an extent of destructiveness. In fact, there appears to be a set purpose in this tendency which takes away from the interest which it might otherwise excite on the score of thoughtlessness and spontaneity."

IN connection with our mention elsewhere of a suit brought by Jno. E. Stowe against the Saratoga Gas and Electric Light Company, we may add (having since seen a copy of Stowe's charge) that complainant, who lived at 75 Catherine street—which is probably a furlong away from the gas plant—claims to have suffered violent spells of coughing and vomiting, without any seeming good cause therefor. Dr. Boyce being called in, finally concluded that his patient was affected by the fumes from the gas works, and this diagnosis was subsequently concurred in by Dr. Moriarta. They advised him to leave his residence, which he did, removing to another point. Hence the suit to recover damages for injury to health and the necessity of choosing another domicile. The case will not be tried for some weeks; and, meanwhile, we might remark—despite the change of location—that complainant still suffers from the causes named in the bill.

AT the ratification meeting of the stockholders to close up the consolidation of the Troy (N. Y.) Gas Light Company, the Troy Citizens Gas Light Company and the Troy Fuel Gas Company, the plans presented were indorsed. The new corporation is to be known as the Troy Gas Company, and its capital stock is $1,000,000: it will manufacture gas for heating and lighting purposes in Troy, Lansingburgh, Brunswick and North Greenbush, Rensselaer county, and in Waterford, Saratoga county. The office and works will be in Troy. The following trustees—to serve one year—were elected: Edward Murphy, Jr., Anthony N. Brady, E. C. Benedict, Samuel O. Gleason, R. C. Pruyn, Geo. P. Ide, Jos. Fales, A. B. Banks, Jas. Fleming, W. A. Thompson, F. J. Molloy, F. E. Draper and William Kemp. After the Trustees have filed the proper articles of incorporation an election for officers will be held, although it is about a settled fact that ex-Mayor Murphy will be chosen President, while Mr. C. E. Davenport will be named to the Treasurership. Bonds may be issued to the amount of $500,000, and the capital stock may be increased by a majority vote of record shareholders. The division of shares was thus made: The old Troy Gas Light Company stockholders receive $600,000 in new shares and $150,000 in bonds, and the bondholders get $80,000 bonds; Troy Citizens Company stockholders, $131,500 in stock and $146,000 in bonds; Troy Fuel Gas Company, $188,500 in stock and $80,500 in bonds. We do not see why the last named securities do not come in for the real cream of the trade.

THE Pittsburgh *Gazette* says that the shortage in the supply of natural gas to the Republic iron mill of that city is causing great inconvenience, the men on the "day turn" having had to shut down during the mornings, because of a request on the part of the natural gas suppliers to the mill owners to run their plant only on the "night turn." To this the men object, and several meetings have been held at which the conclusion was reached to request the mill owners, in case the gas company refuses to furnish a 24-hours' supply of fuel, to return to the use of solid fuel.

THE vacancies in the Board of Directors of the Zanesville (O.) Gas Light Company, occasioned by the deaths of Dr. C. C. Hildreth and Mr. D. C. Comers, have been filled by the election of Messrs. Robert Fulton and C. H. Abbott.

EX-JUDGE THOS. R. ELCOCK, on October 3d, on behalf of the Trustees of the Roman Catholic High School, at Broad and Vine streets, Philadelphia, Pa., appealed to the Supreme Court from the decision of the Court of Common Pleas, in the case of the High School against the city. The authorities of the High School asked the Court to direct the city to introduce gas into the new school building, after the Gas Bureau had refused to put in the pipes until all gas bills left unpaid by former occu-

pants of a portion of the school site had been paid. The first Court held that the city had the right to refuse, and the Supreme Court will now review the case.

THE authorities at Little Rock (Ark.), who are in control of a municipal station for public arc lighting, assert that the cost of each arc (2000-candle power) per annum is $47.50. The mast arm plan is in vogue there. In this estimate no allowance for plant depreciation is made.

"THE projectors of the American Fuel Company, having applied to the authorities of Chelsea, Mass., for an ordinance permitting them to manufacture and distribute fuel gas in that city, a day for a hearing was fixed by the Aldermen. Messrs. Thomas Martin, R. Harris and Capt. Hunter appeared at the time specified, and some very amazing statements respecting the cost and value of the gas which it was proposed to distribute were indulged in. Capt. Hunter is presumed to be the constructing engineer of the syndicate, and he was particularly vaporous over what the Company could and would do in the event of a favorable answer to its appeal. When an attempt was made to cross-examine him—some of the questions asked were: 'Whether the process that was to be employed was now in successful operation elsewhere?' 'What were the leading features of the system?' 'How much money had been paid in?' etc.—he made reply that the 'things were none of their business.' Judge Hutchinson appeared on behalf of the Chelsea Gas Company, in opposition to the petitioners. He asserted that the latter asked this permission from the Board of Aldermen simply, in the event of a favorable verdict, that they might say to unwary capitalists that the city of Chelsea had indorsed their plans. In conclusion, the Judge submitted that if these people were in possession of the secret how to make a good, merchantable fuel gas for 5 cents per 1,000 cubic feet, they were wasting their time in Chelsea; for Boston, New York, Brooklyn, or any of the large cities, stood ready to receive them with open arms and pockets. When the hearing was closed an adjournment was ordered. It is not likely that the petition will be granted.—OBSERVER."

AT a meeting of the stockholders of the Grand Rapids (Mich.) Fuel Gas and Incandescent Lighting Company the following officers were chosen: President, Gen. Wm. Sooy Smith; Vice-President, Adolph Leitelt; Secretary, Fred. S. Clark; Treasurer, W. D. Talford; Directors, Gen. Smith, Adolph Leitelt, Fred. S. Clark and W. D. Talford, of Grand Rapids, and J. F. Aldrich, C. D. Hauk and Jos. Sears, of Chicago.

IN our prior mention of the proposed rate for gas ($6 per 1,000, 70-candle gas) at Williamstown, Mass., it should also have been said that a discount of 5 per cent. will apply on all accounts settled before the 10th of the month, and on all bills exceeding $5 per month an extra discount of 10 per cent. will obtain.

THE Colville (Wash.) Water and Light Company has been incorporated by Messrs. H. W. Mason, Ira Jones and E. D. Miner. Capital, $50,000. The water works division of the enterprise will be first taken up.

THE City Council of Menasha, Wis., has decided to make a contract for the public lighting (arc system) with the Neenah and Menasha Gas and Electric Company. The price to be paid is $5.75 per arc per month.

THE fuel gas projectors are again before the City Council of New Orleans for an ordinance permitting them to pipe the city. This time the ordinance sought for authorizes Louis E. Lemarie and associates to lay pipes and conduits in the city of New Orleans for the purpose of supplying fuel gas for heating and cooking purposes. The price of fuel gas is not to exceed 75 cents per 1,000 cubic feet to the public, and 37½ cents to the buildings and offices of the city on the line of the mains.

Article 3 requires Lemarie and his associates to file with the Mayor, within 90 days after the passage of the ordinance, a written acceptance of its provisions, a failure to do which shall be considered in the nature of a waiver of their right under the ordinance. Work on the buildings, machinery, etc., must be begun within 12 months after the passage of this ordinance. Article 6 is the important amendment. It provides: That the rights and privileges herein conferred shall not in any manner conflict with or infringe upon the exclusive right now enjoyed by the New Orleans Gas Light Company to make and vend gas light for illuminating purposes in the city of New Orleans during the existence of the charter of said Gas Light Company, and the said grantees accept the privileges herein given with the understanding that the city of New Orleans is not to be made liable to any individual or corporation, nor be subject to any legal action which may be brought against said grantees because or by reason of the rights and privileges herein conferred. The city is not to be held responsible for damages, etc., claimed by individuals or corporations against Lemarie and associates, nor for losses or injuries sustained by grantees in case they are deprived of their right, or are interfered with in the carrying out of the privileges given them. Lemarie and his associates are required to deposit a bond of $20,000 on their acceptance of the ordinance or grant, for the faithful performance of their obligations as a party to the contract, etc.

AT a special meeting of the executive committee of the Roanoke (Va.) Gas and Water Company, at the suggestion of the President—the Hon. H. S. Trout—Howard Murphy, the Company's Engineer, was instructed to prepare plans and secure estimates for a considerable extension of the gas and water conduits.

ONE result of Wizard Edison's recent European tour appears to be a determination on his part to cause the rate of wages paid to the employees in his workshops to more nearly approach the rate paid in Europe. In any event, on the first inst. a new code of remuneration was posted up in the Edison lamp works, Harrison, N. J., which code provided that all grades of workmen would thereafter be paid smaller sums for the labor exacted from them. The reduction amounts on the average to 15 per cent. Mr. Edison, of course, can safely put the onus of this move on his "wicked partners," but it cannot be gainsaid that a word or two from him in opposition to the "cut" would have prevented the axe from falling.

ALD. CANN, of Savannah, Ga., is responsible for the presentation to and adoption by the Board of Aldermen of the following:

"*Resolved*, That the Committee on Streets and Lamps are requested to ascertain the best figures upon which the city can obtain a plant of its own sufficient to furnish all lights necessary for lighting the streets and such public buildings as may be desired."

SUPT. JOHN W. NEWELL (who is nothing if not energetic and persevering) is meeting with good success in proving to the residents of New Brunswick, N. J., that heating and cooking by gas are conducive to the ease of the housekeeper, and of comfort to her charges.

AT a sale of securities in Lowell, Mass., on the 5th inst., the gem of the collection was a small lot of Lowell gas—nine shares. The competition for it was very great, and the price paid was $240.50 per share.

MR. E. E. PROCTOR, of Portland, Me., having purchased the shares held by the late Cyrus Wakefield in the "Citizens Gas Light Company, of Reading, South Reading and Stoneham," Mass., a decided change in the policy of the Company has been inaugurated. In the first place, a new staff of officers has been chosen, and it was also determined to apply to the Board of Gas and Electric Light Commissioners for the right to supply electric currents for lighting and power purposes. We are pleased to note this change, and have no doubt that the gas plant will now be brought to that state where it will be in shape to supply the demands of the residents. The reigning officers are: President, W. E. Biddle; Clerk and Treasurer, E. E. Proctor; Directors, A. H. Soden, W. E. Biddle, Geo. F. West, S. K. Hamilton, A. F. Briggs, Geo. P. Wescott, and E. E. Proctor.

THE municipal electric lighting plant operated by the authorities at Ypsilanti, Mich., is said to give fairly good satisfaction. Eighty arc lamps are used in illuminating a section of territory 2 miles in length by 1½ miles in width—1,000-candle power per lamp is said to be obtained, and the lights are extinguished at midnight—at a cost of $23.61 per lamp per annum. No allowance is made for depreciation, nor does interest on plant investment figure in the average.

THE new management at Penn Yan, N. Y., has, by a sensible plan of main enlargement, greatly bettered the conditions under which gas is supplied in the business portion of the district.

JUSTICE ROBERTSON, on the application of the City Solicitor, has issued an injunction restraining the Consumers Gas Company, of Toronto, Canada, from draining its works into the city's sewers. This is another instance of the petty spite so often evidenced by the Toronto authorities against this Company.

The Market for Gas Securities.

The abnormally high rate for money has prevented the market from taking on that buoyancy of tone which well-informed investors confidently looked forward to for development at this season. This stringency, however, is a purely artificial one, and when the manipulators release their grip, which even now weakens, because of the confidently aggressive movements of those who look for a sharp advance in quotations on all classes of securities, the bears might better stand from under. Consolidated remains at 89—88½ was the lowest point touched during the week—and we still look for a good advance before the declaration of the next dividend. Chicago Trusts are weaker, but are worth more than the current quotation implies. Well-informed men are purchasing old Brooklyn gas. The Troy consolidation is cemented, and holders of the "junior securities" are to be congratulated on their slice of the melon.

Advertisers Index.

GAS ENGINEERS. Page

Jos. R. Thomas, New York City ... 528
Wm. Henry White, New York City ... 533
Wm. Mooney, New York City ... 528
William Gardner, Pittsburgh, Pa ... 528
Fred. Bredel, N. Y. City ... 527

PROCESSES.

National Gas Light and Fuel Co., Chicago, Ills ... 522
Bartlett, Hayward & Co., Baltimore, Md ... 529
Wm. Henry White, N. Y. City ... 533
United Gas Improvement Co., Phila., Pa ... 521
Henry Pratt & Co., Chicago, Ill ... 530

GAS AND WATER PIPES.

Gloucester Iron Works, Phila., Pa ... 528
Mellert Foundry and Machine Co., Reading, Pa. (John Fox, Selling Agent, N. Y.) ... 528
Ohio Pipe Co., Columbus, Ohio ... 528
M. J. Drummond, New York City ... 528
R. D. Wood & Co., Phila., Pa ... 530
Warren Foundry & Machine Co., New York City ... 528
Donaldson Iron Co., Emaus, Pa ... 528
Dennis Long & Company, Louisville, Ky ... 528

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City ... 531
Continental Iron Works, Greenpoint, L. I ... 531
Delly & Fowler, Phila., Pa ... 531
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 530
Stacey Mfg. Co., Cincinnati, Ohio ... 531
Bartlett, Hayward & Co., Baltimore, Md ... 529
Morris, Tasker & Co., Limited, Phila., Pa ... 529
Davis & Farnum Mfg Co., Waltham, Mass ... 519
R. D. Wood & Co., Phila., Pa ... 530
Bouton Foundry Co., Chicago, Ills ... 531
Smith & Sayre Manufacturing Co., New York City ... 531
Fred. Bredel, N. Y. City ... 527
United Gas Improvement Co., Phila., Pa ... 521
Henry Pratt & Co., Chicago, Ill ... 530
National Gas Light and Fuel Co., Chicago, Ills ... 522
Simpkin & Hillyer, Richmond, Va ... 517

INCLINED RETORTS.

Laclede Fire Brick Manuf'g Co., St. Louis, Mo ... 487

GASHOLDER TANKS.

W. C. Whyte, New York City ... 522
J. P. Whittier, Brooklyn, N. Y ... 518

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass ... 518

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J ... 526
B. Kreischer & Sons, New York City ... 526
Adam Weber, New York City ... 526
Laclede Fire Brick Manuf'g Co., St. Louis, Mo ... 526
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y ... 526
Borgner & O'Brien, Phila., Pa ... 526
James Gardner, Jr., Pittsburgh, Pa ... 526
Henry Maurer & Son, New York city ... 527
Chicago Retort and Fire Brick Co., Chicago, Ills ... 526
Baltimore Retort and Fire Brick Co., Baltimore ... 526
Oakhill Gas Retort and Fire Brick Co., St. Louis, Mo ... 526
Emil Lenz, New York City ... 526

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md ... 529
Fred. Bredel, New York City ... 527
Chicago Retort and Firebrick Co., Chicago, Ills ... 526
Wm. Henry White, N. Y. City ... 533
J. H. Gautier & Co., Jersey City, N. J ... 527

SCRUBBERS AND CONDENSERS.

G. Shepard Page, New York City ... 488
R. D. Wood & Co., Phila., Pa ... 530

GAS GOVERNORS.

Connelly & Co., New York City ... 523
Fred. Bredel, N. Y. City ... 527
Friedrich Lux, London, England ... 527

SELF-SEALING MOUTHPIECE DOORS.

Smith & Sayre Mfg. Co., New York City ... 527

TAR AND CARBONIC ACID EXTRACTOR.

Geo. Shepard Page, N. Y. City ... 520

CEMENTS.

C. L. Gerould & Co., Brooklyn, N. Y ... 526

GAS ENRICHERS.

Standard Oil Co., Cleveland, Ohio ... 532

GAS METERS.

Harris, Griffin & Co., Phila., Pa ... 534
American Meter Co., New York and Philadelphia ... 535
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa ... 535
Helme & Melihenny, Phila., Pa ... 535
D. McDonald & Co. Albany, N. Y ... 535
Nathaniel Tufts, Boston, Mass ... 534
Maryland Meter and Manufacturing Co., Baltimore, Md ... 534
John Hillen, Brooklyn, N. Y ... 534

EXHAUSTERS.

P. H. & F. M. Roots, Connersville, Ind ... 519
Smith & Sayre Manufacturing Co., New York City ... 531
Wilbraham Bros., Philadelphia, Pa ... 523
Connelly & Co., New York City ... 523

GAS COALS.

Penn Gas Coal Co., Phila., Pa ... 533
Perkins & Co., New York City ... 532
Newburgh Orrel Coal Co., Baltimore Md ... 533
Despard Coal Co., Baltimore, Md ... 533
Chesapeake and Ohio R. R. Coal Agency, N. Y. City ... 533
Westmoreland Coal Company, Phila., Pa ... 533
J. & W. Wood, New York City ... 532

CANNEL COALS.

Perkins & Co., New York City ... 532
J. & W. Wood, New York City ... 532

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y ... 524
John McLean, New York City ... 524
Chapman Valve Manufacturing Co., Boston, Mass ... 524
R. D. Wood & Co., Phila., Pa ... 530

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa ... 504
Clerk Gas Engine Co., Phila., Pa ... 524
Van Duzen Gas Engine Co., Cincinnati, Ohio ... 524

ENGINES AND BOILERS.

Jarvis Engineering Co., Boston, Mass ... 523
Ball Engine Co., Erie, Pa ... 518
Westinghouse Machine Co., Pittsburgh, Pa ... 523

GAS LAMPS.

G. Shepard Page, New York City ... 524
Standard Gas Lamp Co., Phila., Pa ... 518
Welsbach Incandescent Gas Light Co., Phila., Pa ... 518

PURIFIER SCREENS.

John Cabot, New York City ... 524
Geo. A. Mills, Baltimore, Md ... 524

GAS STOVES.

American Meter Co., New York and Philadelphia ... 525
The Goodwin Gas Stove and Meter Co., Phila. Pa ... 536

STREET LAMPS.

J. G. Miner, Morrisania, New York City ... 486
Bartlett Street Lamp Man'fg Co., New York City ... 518

BURNERS.

C. A. Gefrorer, Phila., Pa ... 532

STEAM BLOWER FOR BURNING BREESE.

H. E. Parson, New York City ... 492

PURIFYING MATERIAL.

Connelly & Co., New York City ... 523
Friedrich Lux, London, England ... 527
Edgewater Lime Works, Edgewater, N. J ... 527

COKE CRUSHER.

C. M. Keller, Columbus, Ind ... 533

ELECTRICAL APPARATUS.

Wm. Henry White, N. Y. City ... 533

BOOKS, ETC.

Gerould's System Gas Bookkeeping ... 527
1889, Directory, 1889 ... 368
King's Treatise ... 528
Scientific Books ... 534
Management of Small Gas Works ... 524
Gas vs. Electricity ... 462
Practical Electric Lighting ... 523
Electric Light Primer ... 538
American Gas Engineer and Superintendents' Handbook ... 369
Digest of Gas Law ... 350

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As Superintendent of Gas Works,

By a young man who is thoroughly familiar with Oil, Coal, and Water Gas, and has fair knowledge of Electricity. Graduate chemist of School of Mines, N. Y. Address

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Or as Gasfitter, or to do general work, by a man who has had sixteen years experience in the manufacture and distribution of gas. First-class references. Address

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Our Patent System of Instantaneously Lighting Gas (without electricity), for Railroad Depots is unequaled.

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The Seventeenth Annual Meeting of the American Gas Light Association

Will be Held at Baltimore, Md., Oct. 16, 17 & 18.

Persons thinking of joining the Association should read the following extract from the Constitution: "SEC. 12. Applications for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least ten days prior to the meeting at which the application is acted on." Application blanks will be furnished by the Secretary.

Lawrence, Mass. **C. J. P. HUMPHREYS, Secretary.**

WELSBACH SYSTEM

OF

Incandescent Gas Lighting.

OFFICE, DREXEL BUILDING, PHILA., PA.

At a Meeting of the Gas Trustees of the City of Findlay, held August 28th it was "Resolved, That we recommend the general adoption of the Welsbach Light, owing to its excellence and economy in the use of gas."

Gasholder Tanks & Gas Works Masonry Complete.

PLANS PREPARED AND ESTIMATES FURNISHED AT SHORT NOTICE.

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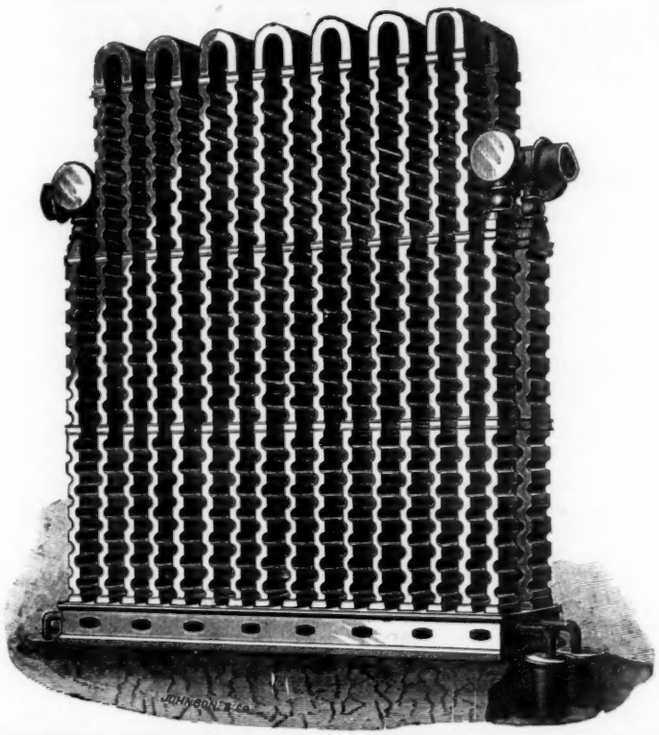

We desire to draw the attention of the gas community to the merits of the SINUOUS FRICTION CONDENSER. Companies intending to introduce new condensers into their works will do well to confer with us and examine plans and estimates before contracting for any other pattern The FRICTION CONDENSER is now in use at the gas works located in the following places:

Portland, Me.	Brookline, Mass.	Pawtucket, R. I.	Fredericton, N B.
Newport, R. I.	Chelsea, Mass.	Jamaica Plain, Mass.	St. John, N. B.
Gloucester, Mass.	Woburn, Mass.	Attleboro, Mass.	Paterson, N. J.
Newton & Watertown, Mass.	Peoria, Ill.	Calais, Me.	Dover, N. H.
	Clinton, Mass.	Fall River, Mass.	Waltham, Mass,

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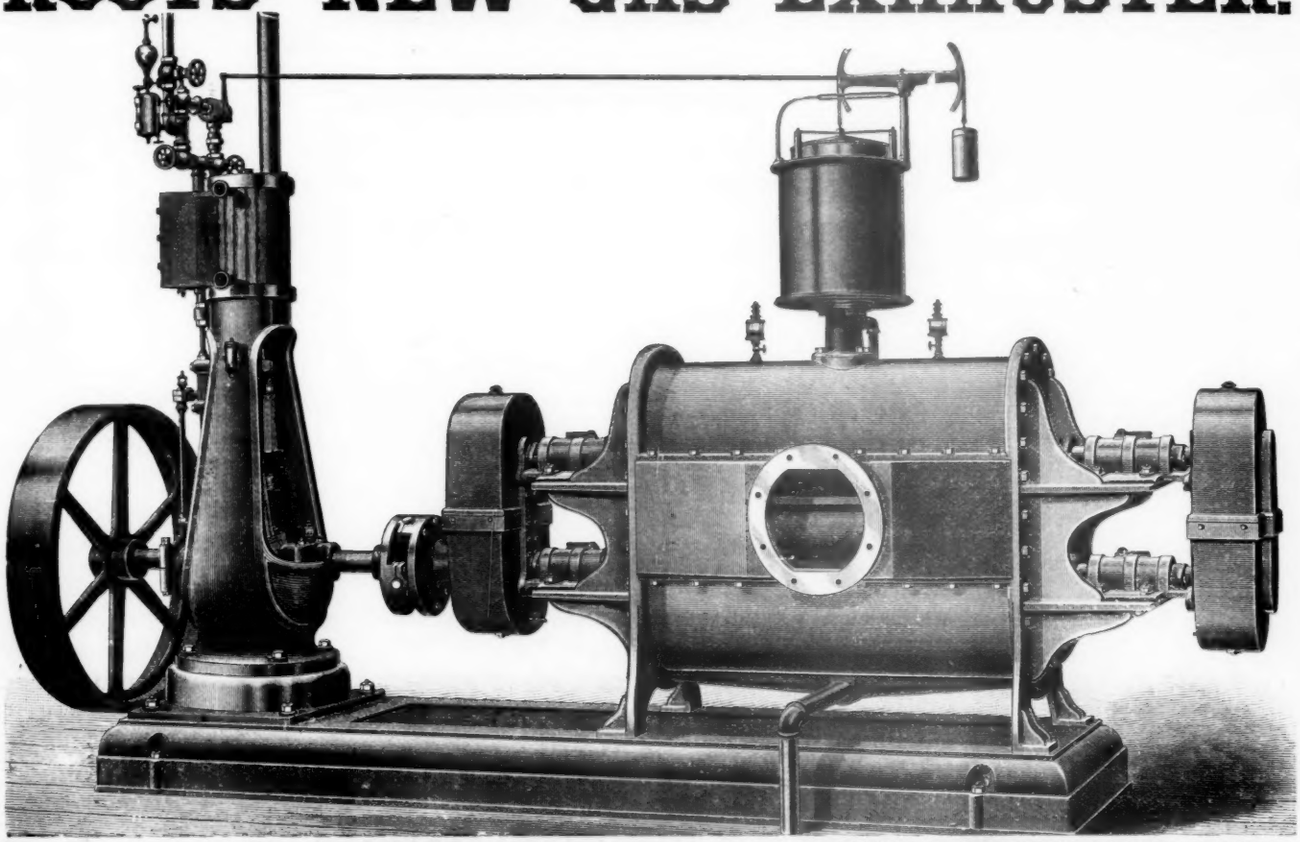

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WALKER TAR AND CARBONIC ACID EXTRACTOR.

A very general demand exists, in both large and small Gas Works, for an apparatus that will be absolutely efficient in the removal of the tar which passes the hydraulic main and condenser. Many attempts have been made to accomplish this, but, I believe, without success, until the introduction, five years ago, in England, of the C. & W. Walker Patent Tar and Carbonic Acid Extractor. During these years this apparatus has been adopted by many of the most prominent Engineers, not only in England, but also on the Continent of Europe and in other parts of the world. It is only necessary to give here a partial list in order to convince any intelligent American Gas Engineer that this machine must have succeeded fully in accomplishing the desired results.

The following Engineers have personally given permission to refer to them:

G. C. Trewby, Esq., Engineer-in-Chief of the Gas Light and Coke Co., London. The manufacturing plant at Beckton is built in complete sections of 3,000,000 cubic feet capacity each. A Walker Tar Extractor has been fitted to each one of these sections. This was done after a long and thorough trial on one of its sections. The Tar Extractor has been supplied to other works of the Gas Light and Coke Co., including those of which John Methven, Engineer of the Gas Light and Coke Co. at the Nine Elms Station, is in charge. Also to G. E. Stevenson, Peterborough Gas Works; B. Green, Mitcham and Wimbledon Gas Works; W. H. Smith, Bedford Gas Works; F. Linging, Norwich Gas Works; J. T. Browning, Colchester Gas Works; S. B. Darwin, Portsmouth Gas Works; J. McCrae, Dundee Gas Works; W. J. Wells, Stamford Gas Works; J. M. Darwin, Longton Gas Works; J. Paterson, Warrington Gas Works; and J. Coulter, of the Dundalk Gas Works. All of the foregoing gas works are located in Great Britain.

Mr. Charles A. Gerdenier, Superintendent of the Bridgeport (Conn.) Gas Light Company, writes as follows, under date of Dec. 3, 1887:

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers."

I have taken the Agency for the United States for this apparatus, and am now prepared to make contracts to erect it on the premises of any Gas Company. It would be manufactured in the following sizes:

No. 1,	50,000 to	100,000	cu. ft. per 24 hrs.,	3	ft.	square,	5	ft.	deep.
No. 2,	" "	125,000	" " "	4	"	"	"	"
No. 3,	" "	250,000	" " "	5	"	"	"	"
No. 4,	" "	500,000	" " "	6	"	"	"	"
No. 5,	" "	750,000	" " "	7	"	"	"	"
No. 6,	" "	1,000,000	" " "	8	"	"	"	"
No. 7,	" "	1,250,000	" " "	9	"	"	"	"
No. 8,	" "	1,500,000	" " "	10	"	"	"	"
No. 9,	" "	2,000,000	" " "	12	"	"	"	"
No. 10,	" "	3,000,000	" " "	15	"	"	"	"

This Tar Extractor will perform its work with about one-fourth the usual back-pressure heretofore required. It is simple in construction, and can be supplied at a very reasonable price—less than any other ever before introduced. Satisfactory results will be guaranteed in every instance.

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Fuel and Illuminating Water Gas Works.

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Illinois Light, Heat & Power Co.	Chicago, Ill
Elgin National Watch Co.	Elgin, Ill.
C. R. I. & P. R. R. Shops	Chicago, Ill.
Decatur Gas Lt & Coke Co.	Decatur, Ill.
Niles Gas Light Co.	Niles, Mich.
Newton Illuminating Co.	Newton, Kansas.
Wellington Light & Heat Co.	Wellington, Kansas.
Chippewa Falls Gas Lt. Co.	Chippewa Falls, Wis.
Elkhart Gas Lt & Coke Co.	Elkhart, Ind.
Madison City Gas Light Co.	Madison, Wis.
South Bend Gas Light Co.	South Bend, Ind.
Sheboygan National Gas Co.	Sheboygan, Wis.
Salina Gas Light Co.	Salina, Kansas.
The Rathbun Co	Deseronto, Prov. Ont.
Jefferson City Gas Lt. Co	Jefferson City, Mo.
Mankato Gas Light Co.	Mankato, Minn.
Lima Gas Light Co.	Lima, Ohio.
Minneapolis Gas Light and Coke Co.	Minneapolis, Minn.
Bellevue Water and Fuel Gas Light Co.	Bellevue, Campbell County, Ky.
Bucyrus Gas Lt. & Fuel Co.	Bucyrus, Ohio.
Morris Gas Co.	Morris, Ill.
Los Angeles Gas Co.	Los Angeles, Cal.
San Diego Gas Fuel & Electric Lt. Co.	San Diego, Cal.
Sioux Falls Gas Co.	Sioux Falls, Dak.
Dakota Gas and Fuel Co.	Grand Forks, Dak.
St. Johns Mutual Gas Co.	St. Johns, Mich.
Stillwater Gas Light Co.	Stillwater, Minn.
St. Paul Gas Light Co	St. Paul, Minn.
Emporia Electric and Gas Light Co.	Emporia, Kas.
Van Wert Gas Light Co.	Van Wert, Ohio.
Lansing Gas Light Co.	Lansing, Mich.
San Francisco Gas Lt. Co.	San Francisco, Cal.
Shelbyville Gas Light Co.	Shelbyville, Ind.
Great Falls Gas Light Co.	Great Falls, N. H.
Belleville Gas Co.	Belleville, Ontario
Rochester Lt. and Fuel Co.	Rochester, Minn.
Northwestern Gas Light and Coke Co.	Evanston, Ill.
Lincoln Gas Light Co.	Lincoln, Neb.
Davenport Gas Light Co	Davenport, Iowa.
Municipal Gas Co.	Albany, N. Y.
Alliance Gas Light Co.	Alliance, Ohio.
New Gas Light Co.	Janesville, Wis.
*Chicago Gas Light & Coke Co.	Chicago, Ill.
*Joliet Gas Co.	Joliet, Ills.
*Superior Light & Fuel Co.	Superior, Wis.
*Kewanee Gas Light Co.	Kewanee, Ill.
*Standard Gas Light Co.	New York City.

* Building.

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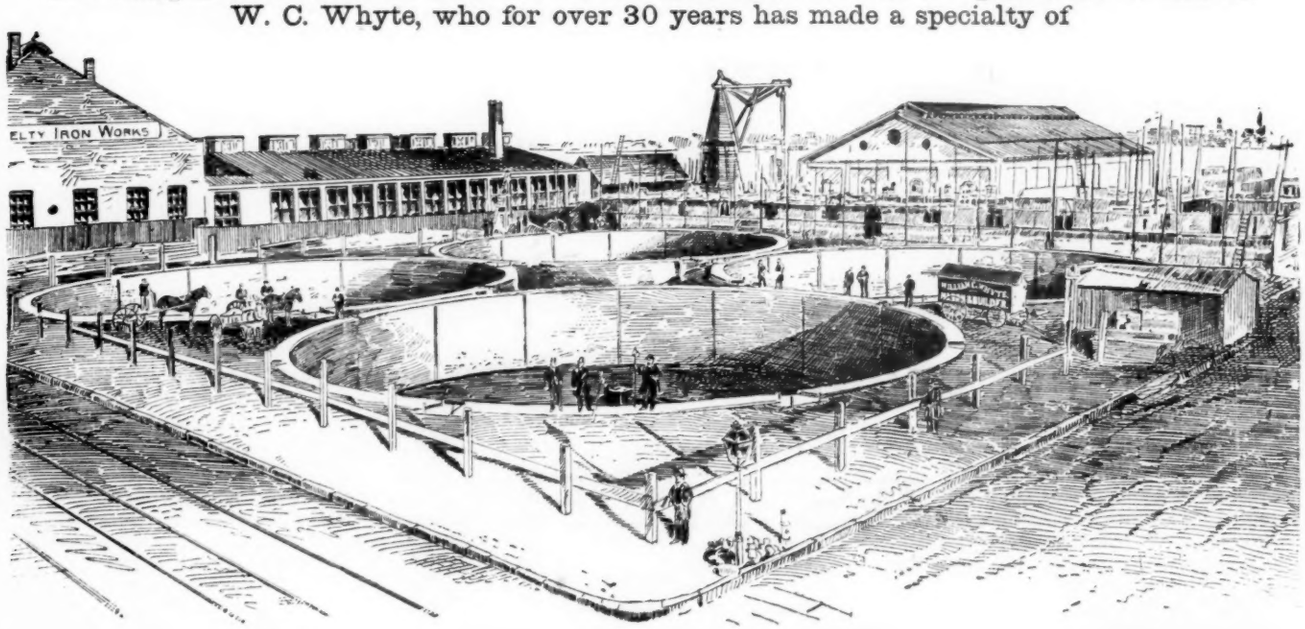

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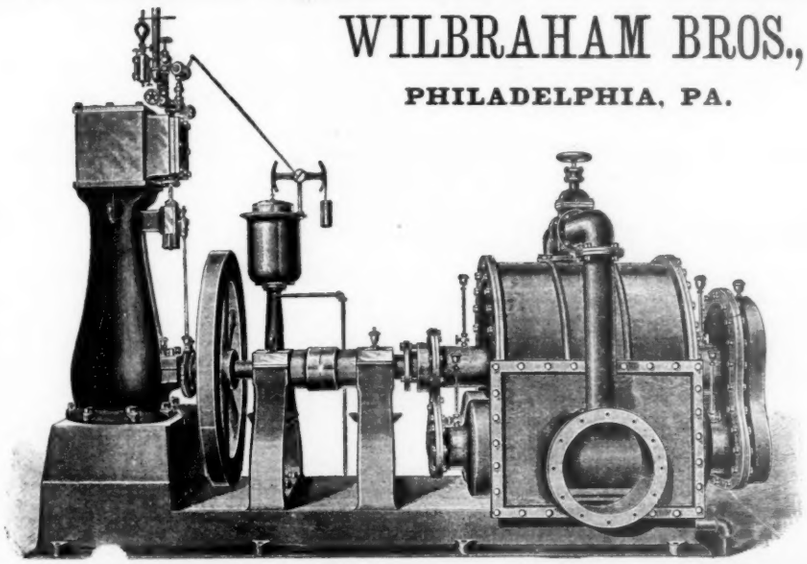

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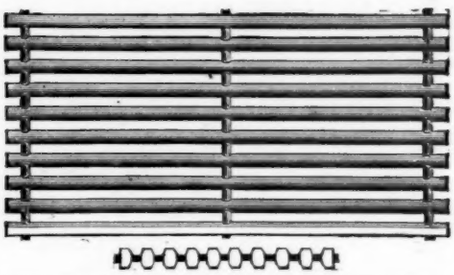

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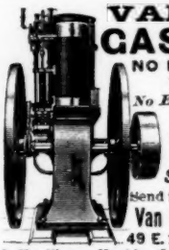

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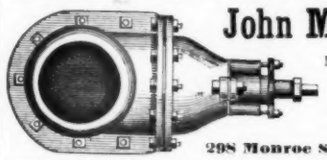

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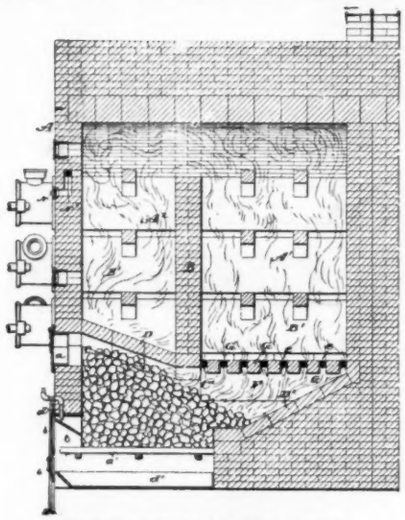

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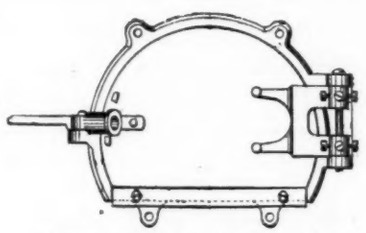

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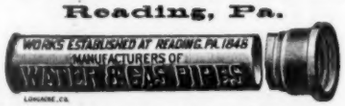

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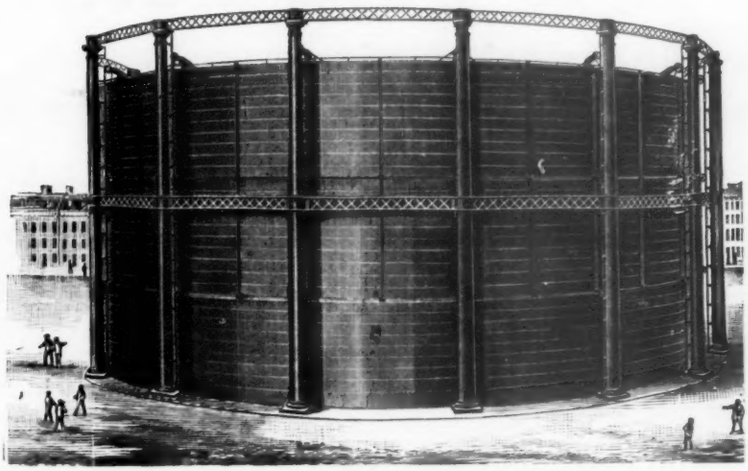

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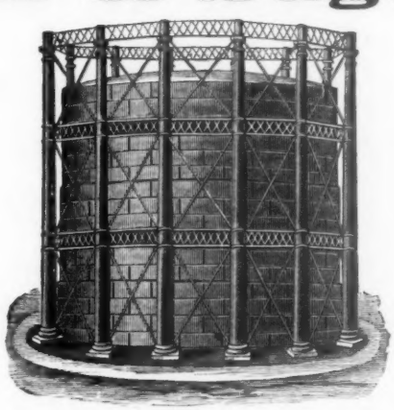

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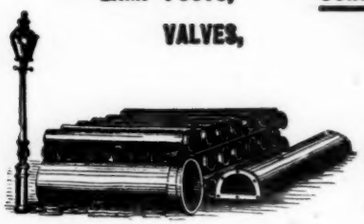

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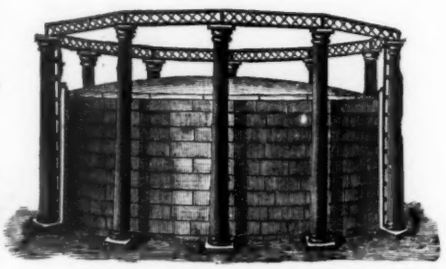

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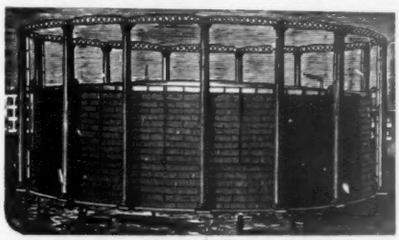
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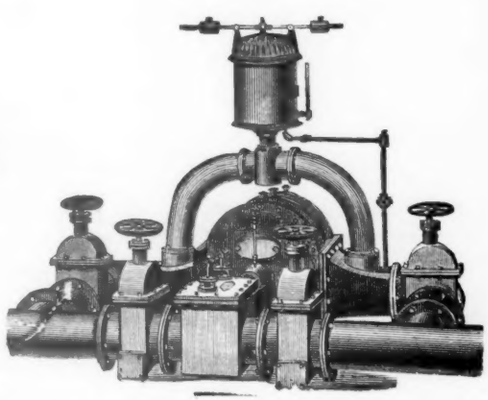

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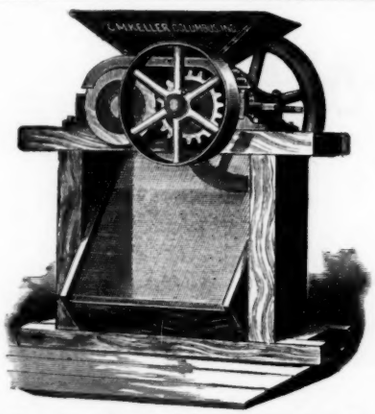

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20 in. wide.	17½ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.
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17 in. wide.	14¼ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep.		

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